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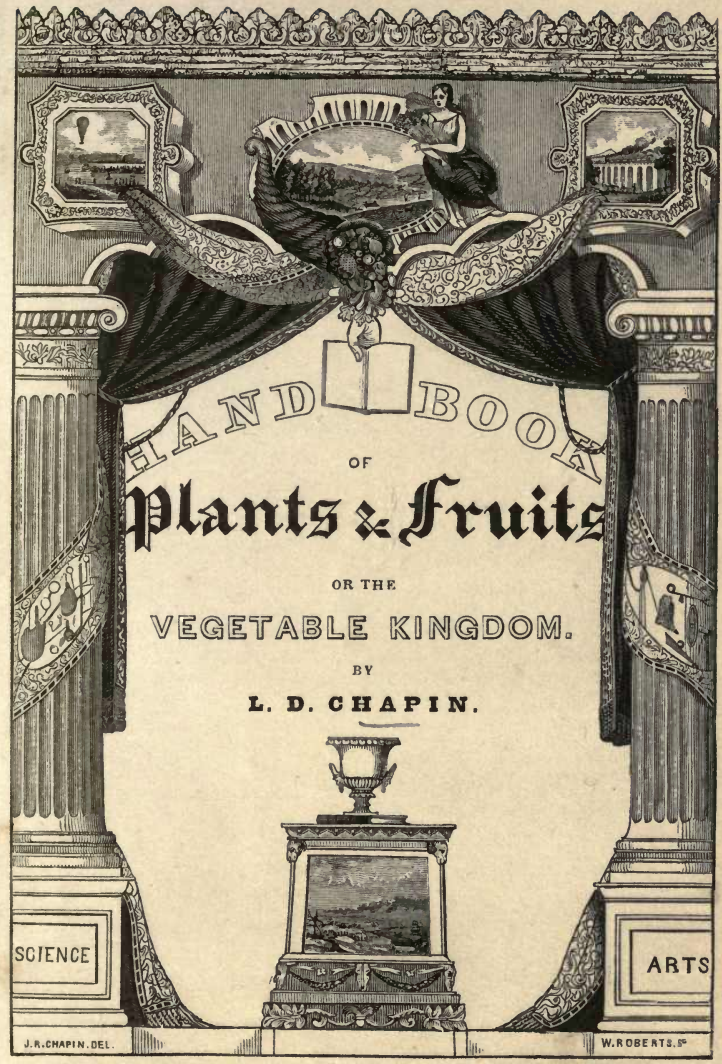
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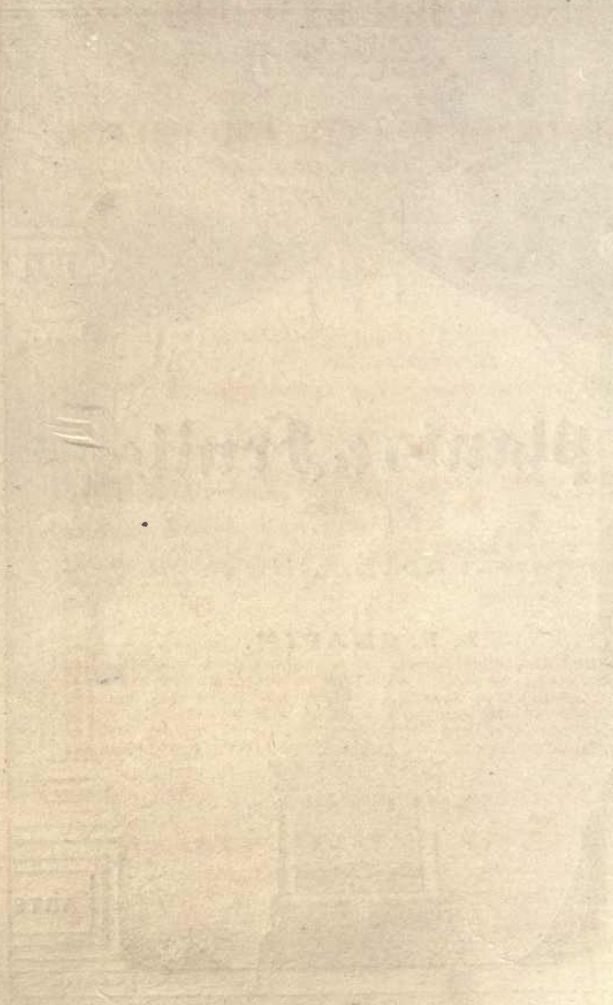




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HAND BOOK
OF
Plants & Fruits
OR THE
VEGETABLE KINGDOM.
BY
L. D. CHAPIN.
SCIENCE
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THE

VEGETABLE KINGDOM;

OR,

HAND-BOOK OF PLANTS AND FRUITS.

BY

L. D. CHAPIN.

WITH ONE HUNDRED AND FORTY ILLUSTRATIONS, A COPIOUS GLOSSARY, ETC.

Comprising:

PART I.

VEGETABLE PHYSIOLOGY,
ANATOMY OF PLANTS,
ORGANS OF PLANTS,
COMPARATIVE PHYSIOLOGY,
PRINCIPLES AND KINDS OF PLANTS,
BOTANICAL CLASSIFICATION,
VEGETABLE CHEMISTRY,
CHEMISTRY OF AGRICULTURE,
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AMERICAN VEGETATION,
VEGETABLE REGIONS,
AGENCY OF LIGHT, HEAT, AIR, MOISTURE,
GEOLOGICAL CHARACTER OF SOILS,
HEALTH, FOOD, AND HABITS OF PLANTS,
VEGETABLE ALIMENTARY PRINCIPLES,
NUTRITIVE QUALITIES OF PLANTS,
USES OF VEGETABLE FOOD.

PART II.

CEREAL GRAINS, OR CORN PLANTS,
FOOD OF ANCIENT AND MODERN NATIONS,
VEGETABLE INTOXICATING AND OTHER DRINKS,—TEA, COFFEE, &c.
SUGAR, COTTON, HEMP, FLAX, TOBACCO,
COAL, SILK, HONEY, PAPER, POTASH,—THEIR NATURE, USES, STATISTICS,
ESCULENT ROOTS, SPICES, &c.
AROMATIC PLANTS AND SEEDS,
LEGUMINOUS, ALLIACEOUS, CRUCIFEROUS, ACETARIOUS, ASPARAGINOUS, SEASONING, SALAD, POT, MISCELLANEOUS, AND ALL EDIBLE GARDEN, FIELD, AND WILD PLANTS; THEIR VARIETIES, PROPERTIES, COMPOSITION, USES, EFFECTS, CULTURE, &c.

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By L. D. CHAPIN,

Published by JEROME LOTT, 156 Fulton Street, N. Y.

Illustrated by 140 *Engravings, Maps, Copious Glossaries, &c.*

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MEDICINAL PLANTS—their culture, properties, preparation, chemical composition, administration, with remarks, etc.

GUMS AND ACIDS—their character, modes of preparation and various uses.

PLANTS USEFUL IN THE ARTS—Including forest trees used in the mechanic arts, and others used in dying and for the various domestic purposes, etc.

FOREST TREES—Their important character, relative qualities, uses, propagation, etc.

ORNAMENTAL TREES, SHRUBS AND VINES.

CURIOUS AND REMARKABLE PLANTS. Also—*Plants useful in Agriculture.*

GARDENING and *Garden Plants.*

GRASSES, their kinds, qualities, culture American Grasses, etc.

USEFUL AND ORNAMENTAL FLOWERS their culture, properties, and all other interesting particulars.

TABLE OF IMPORTANT FACTS and an APPENDIX, embracing all the latest discoveries and improvements in the various branches of Agriculture, particularly, in the adaptation of plants or fruits to the useful and ornamental purposes of life.

INTRODUCTION.

Nothing contributes more to the pleasures and necessities of man than the productions of the vegetable kingdom. Every constituent of the bodies of man and animals is derived from them, not a single element being generated by the vital principle. We must see, consequently, that they constitute the fountain of animal life from which are derived, not only the vital energies that animate the world of organic beings, but all the comforts and luxuries of our race, both in a civilized and barbarous state. Whether we regard them, therefore, as essential to the life and growth of animals which furnish us with food, or partake of them as they are presented us immediately from the bountiful hand of nature, they are alike important to mankind. Nor do they, as articles of food, contribute more to the gratification of the animal taste than they do, as beautifully organized beings, to the mental taste and the rational indulgence of the noblest faculties of mind.

Again, it is not only in the life, the health and the growth of the animal body that we perceive the importance of vegetable productions, but likewise in the unlimited materials they alone afford us for protecting and preserving it from injury and death; and that, too, in a manner alike necessary for comfort and for the gratification of the caprice and the most diversified tastes of society. Under any circumstances, therefore, in which the life, the interests and pleasures of man are concerned, they constitute the most important subject which can engage our attention.

But it is deserving of remark that the majority of people, perhaps, and even those of the most cultivated society, are singularly ignorant of the character and nutritive properties of the most distinguished products of vegetable nature; except so far, perhaps, as they confer a momentary sensation of animal taste, felt equally by all the lower orders of animals which are necessarily unconscious of their origin, nature and tendency. It is but reasonable to assert, however, that it is the interest as well as the pleasure of every intelligent mind, above that of the mere vegetative animal, to inquire into the causes, effects and qualities of productions thus essential to life and the enjoyment of the physical and social condition of man.

What, indeed, would be that condition and that of the whole animal world, if it were possible otherwise to exist, without the resources and beauties of the vegetable kingdom? Not only would the face of the earth be devoid of all that is now lovely, rich, animating and productive in herb, shrub and tree, foliage, blossom and fruit, but nowhere would be seen the splendid arts of man which now adorn and diversify it. Naked and houseless should we roam the bleak and barren world, shrunk and deformed by withering blasts, or scorched beneath a torrid sun, with all around a wide, wild and desolate waste.

But little better should we be, enriched, enlivened and beautified as is our fair earth, with all that is useful, charming and fruitful, were we unacquainted with the nature and properties of the vegetable productions by which we are surrounded. Thus, then, whilst nature cheers and animates the world, and pours forth her fruitful treasures upon the earth, she would be, in all else, rude and desolate but for the use made of her bounties by the genius and necessities of man. Hence it was at the first, and now is, our greatest interest and pleasure to become acquainted with the vegetable products designed for our life and happiness.

But, though necessity has taught us the use of many of those products so important to life, and fashion that of others for the mere luxury of sense, we are still unacquainted with many of their most valuable qualities; nor are the majority familiar with a tithe of what has been, or may be known of their utility in the various purposes of life. Nature does, indeed, point us to our beautiful mother earth, and ask us to contemplate her all-bountiful bosom, of which we are so waywardly neglectful. She has spread for us a luxurious repast in the vegetable kingdom—substances innumerable that may be reproduced and multiplied in quantity and variety without limits. She invites us within her banqueting house and bids us select for ourselves among the choicest of her products. She does not, as with many, demand even the gathering, but she points out the best products and suggests to us the uses to which they may be applied, in numerous ways, to our wants in health and disease, or to our greatest convenience or luxury as food, or as important objects in the useful and ornamental arts.

To render thus familiar, then, the products and uses of vegetable nature, as already determined by and known to others, and to induce persons to reap the advantages of those uses, without the inconveniences of experience, is the design of the following pages. For this, little or no studied or practical effort is necessary. The whole is intended to exhibit the nature and useful qualities of fruits and vegetables, so that any one may become familiar with them, or apply them to his use in all the varied purposes of life; and also that he may not at all times depend on the dictum of the inexperienced, or the caprice and cupidity of the interested, but may serve himself better and always in a manner most satisfactory, economical and safe.

The whole study of life, in earlier periods of man, was necessary to acquire a knowledge of fruits and plants essential to health and existence; and the longest was incapable of affording an approach to the comforts and luxuries now known and enjoyed. An hundred generations devoted to this object were unequal to what may now be acquired in a few hours' quiet reading—reading which, unlike much of that of the present day, contributes immediately to the length, utility and pleasures of existence,—which enlarges our views of creative wisdom and power and gives no false coloring to life—which improves the morals, taste and judgment and is eminently useful and instructive in all the individual and social interests of life.

A glance at some of the uses of a few vegetable products in the common purposes of life—the arts and sciences—in commerce and manufactures—agriculture—the fine arts—the various purposes of clothing —in medicine—for fuel—for the food of man and animals, &c., exhibits a general, though imperfect, idea of their importance. The use of *cotton* in the annual fabrication of hundreds of millions of yards of cloth, worn for comfort and ornament by as many millions of people—of *flax*, in the manufacture of *linen* so generally worn throughout the civilized world—of the *mulberry plant*, which feeds thousands of millions of worms for the production of *silk*, worn so extensively by the people of all civilized nations—the *roots of plants*, the chief food of people in a large part of the world and used in numerous ways as medicines, and as food for cattle, (the tuberous and bulbous, as the potato, onion, carrot, beet, turnip, etc., entering so largely into the mass of wholesome nutriment)—the *leaves of plants*, widely used for dyes, food, &c.—the *bark of trees*, used so extensively for tanning, for dyes, cordage and food—the *gums and resins* so important in the various useful and ornamental arts, for medicinal purposes, etc.—the *juices of plants*, so valuable and important, distilled and concrete, as sugars, syrups, or molasses, or as beverages and drinks of numerous kinds and for medicinal uses, etc.—the *vegetable alkalies*, so important in the arts and sciences —the various *vegetable oils*, volatile and essential, extensively used in the useful and ornamental arts of life, for domestic purposes, for medicines and for essences in perfumery, etc.—the innumerable *varieties of wood* used and indispensible in house building, ship building, cabinet work, for musical instruments, domestic articles, both useful and ornamental and, in truth, for every art of life, for fuel, for the comfort and preservation of life and in the preparation of food, etc.—*hemp* for sail cloth and ropes, indispensable in commerce, for ticking, bagging, cords, twine, etc., and so much used for all practical purposes in society—the *reeds*, greatly used in the arts for chair bottoms, umbrellas and for their juices, as sugar, treacle, or distilled into spirits of various kinds—*pine pitch, tar and rosin*, as used in ship building, for producing gas for lighting cities and for numerous purposes in the arts—*seeds* for the pro-

duction of oils of various and important kinds, so important in the arts for seasoning food and for the great purpose of perpetuating their species—*flowers* that bedeck the earth with beauty, supply the bee with honey, and serve for food and as medicines—*herbs* that supply the table with sauces, greens, seasonings, &c., of every variety and quality—*stalks*, as food for cattle, for making paper, sugar, etc., for thatching, for beds, &c.—the various *grains* or *corn*, prepared as bread in innumerable ways and emphatically "*the staff of life*," as food for man and cattle, or distilled into spirits of various kinds—the *leaves of tea*, so universally drank as a beverage—*coffee* so commonly used as a drink and almost as food—*Chocolate* little less used as a beverage in various parts—the *vegetable acids*, so extensively used for domestic purposes and in the arts—*all the varieties of fruits* that serve so many purposes in life and are so valuable as food in all forms, and their juices as used for drinks made into wines of every variety and for culinary purposes, or as *berries*, so valuable in the arts and so luxurious as food, crude or prepared.—But time and space fail in the enumeration of the endless variety of purposes to which fruits and vegetables are appropriated in life; a consideration of them separately therefore, can alone furnish a knowledge of their practical utility, or convey an idea of the range of our subject.

EXPLANATORY.

In the brief notice here given of the useful properties, the nature and organism of fruits and plants, little will be expected from us as to the various modes of their cultivation, or in relation to their botanical arrangement. These branches of science are to be found distinctly treated in other works; besides which they might appear less entertaining to the mass of readers than the general and popular view we have taken of our subject. Nor should we be expected to pay much regard to style, as the object of the writer has been merely to state remarkable facts as to the organization and functions of plants; and to condense into short notices and paragraphs whatever is practical in the uses to which each fruit or plant has been applied, for food, for medicinal purposes, or in the arts and domestic economy. Upon these subjects, and as objects of interest and curiosity, the writer trusts that sufficient has been said as to the nature and qualities of plants and their productions, to awaken attention, and to induce their examination as a branch of the most useful and entertaining knowledge. All persons being individually interested in a knowledge of their characteristics and uses, it should be evinced through life. An unknown property or a new mode of application of but one kind of fruit or vegetable, may prove of more value than the price of fifty such books as this. It cannot, therefore be a matter of indifference with any one as to the nature of objects which enter, in some shape, into every department and purpose of individual and social life. No work which we have

noticed, has taken the view of the subject here presented; and, as few subjects are of more importance and yet few as little understood, our design has been to render it entertaining and popular with the great body of readers, instead of claiming the discovery of any new facts, or deducing any new theories therefrom.

In the outlines of *vegetable physiology* much information it is believed has been condensed, less however with regard to system than usefulness. And, in our general review of vegetable nature, a wide field of observation is glanced over for the purpose of exhibiting the range of our subject, and to encourage a more particular acquaintance with it. This, indeed, is a primary object of the work; and the reader is therefore heartily invited to extend his acquaintance with the vegetable kingdom as the most productive source of pleasure and advantage.

GLOSSARY.

A, privation, or destitute of; as *acaulis*, a plant without a caulis or stem.

Abortive flower. Falling off without producing fruit; stamens without anthers. Pistil, defective in some essential part. Seed, imperfect, through want of pollen.

Abrupt pinnate leaf, with an old or terminal leafet.

Absorbent. A vessel which sucks up liquid.

Acetate, a salt composed of acetic acid, or vinegar, and a base.

Acrid, having a hot biting or bitter taste.

Acotyledonous. (From *a* without, and *cotyledon*, a seed lobe.)

Acuminate. Taper-pointed, the point mostly curved towards one edge of the leaf, like an awl.

Acclimatized to become inured to the climate.

Adjuvant, helpful assistant.

Æriform, resembling air. *Areation*, to render like air.

Affinity, apparent preference a substance has for another, connection.

Agamous. (From *a*, without, and *gamos*, marriage.)

Ages of plants. *Ephemeral*, such as spring up, blossom and ripen their seed in a few hours or days; *annual*, living a few months or one summer; *biennial*, springing up one summer and dieing the following; *perennial*, living an indefinite period.

Aggregate. Many springing from the same point—*aggregate*, *compound*, *umbellate*, *cymose*, *amentaceous*, *glumose*, *spadiceous*.

Aggregate flower, erected on footstalks; all have one common receptacle on the stem.

Alburnum (From *albus*, white.) Soft white substance in trees between the liber, or inner bark. It is the *sapwood*, formed by a deposite of the *cambium*, or descending sap; in one year it becomes wood; and a new layer of alburnum is again formed.

Albumen, the farinaceous part secreted in most monocotyledonous seeds or fruits, between the embryo and outer skin, furnishing the flower chiefly of the corn plants, and composed of similar chemical characters with the albumen of animals: it is never poisonous, though the plants may be.

Algæ. Flags; plants of the order *Hepaticæ* and *Lichens*.

Alkalies, fixed salts, composed of oxygen and an earth, as soda, potash, etc. These neutralize and form salts with the acids.

Alkaloids, substances like alkaline bases, of vegetable origin and composed of oxygen, hydrogen, carbon, and nitrogen.

Alpine. Growing naturally on high mountains

Alternate. Branches, leaves, flowers, etc. beginning at different distances on the stem; *opposite*, is when they commence at the same point, base standing against base.

Alveolate, with cells resembling a honeycomb.

Ament. Flowers collected on chaffy scales, on a thread or slender stalk; a catkin.

Ammonia, a volatile alkali existing chiefly combined with acids and forming salts: in the form of gas, its pure state, it is composed of nitrogen and hydrogen.

Amylaceous, of the nature of starch.

Analysis. (Botanically.) To ascertain the name, by observing the organs, and comparing them with scientific descriptions of plants; separation of parts.

Anatomy, the structure or organization of vegetables or animals.

Animal Charcoal is commonly prepared by boiling the refuse of slaughter-houses and mixing it with sifted coal ashes.

Androgynous plants. Bearing staminate and pistillate flowers on the

same root; as the oak and Indian corn: class Monœcia.

Angiospermal. Plants whose seed are enclosed or covered.

Annual. A plant living but one year. The herbage is often annual, while the root is perennial; the plant is then *perennial.*

Annulus.. A ring, *annular*, ringlike.

Anomalous. (From *a*, without, and *nomos*, law.) Irregular, whatever forms an exception to a general rule.

Anther. (From *anthos*, a flower) part of the stamen which contains the pollen; it is of various forms.

Antheriferous. Flowers bearing anthers without filaments.

Antiscorbutic. Curing eruptions or scurvy.

Antacid, remedy for acidity or sourness.

Apetalous. (From *a*, without, and *petalum*, a petal.) Having no petals or corollas; flowers *incomplete;* destitute of stamens or pistils; they are *imperfect.*

Aphyllous. (From *a*, without, and *phyllon*, a leaf.) Destitute of leaves.

Appendaged. Having bracts, thorns, prickles, etc.

Aquatic. (From *aqua*, water.) Growing in, or near water.

Arenarius. Growing in sand. *Arid.* dry.

Argillaceous, consisting of clay or alumine.

Arms, (*arma.*) Plants are armed when furnished with prickles, thorns, etc.

Aromatic. Sweet-scented.

Aroma, odour, purfume.

Arrow-form. Shaped like an arrowhead, hind lobes acute, saggitate.

Artificial Manure, (Daniel's,) is wood in powder saturated with bituminous and animal matters of any kind, and then mixed with soda and quicklime.

Articulated. Jointed; as in the culm or stem of the grasses.

Arvensis. Growing in cultivated fields.

Assimilation, the act by which organized bodies incorporate foreign substances and convert them into their own substance.

Awn. A short stiff bristle.

Axil. Angle between a leaf and stem on the upper side.

Axillary. Growing out of the axils; leaves are axillary when they proceed from the angle formed by the stem and branch.

Axis. The elongated part of a petiole, on which are many flowers. A centre.

Base in chemistry, applied to metalic oxides or the leading constituents of compounds; thus soda is the base of sulphate of soda, (Glauber's salts) and of sulphate of magnesia, (Epsom salts.)

Bacca. (Berry.) A pulpy pericarp, enclosing seeds without cupsules. A berry is *proper* when formed of the pericarp or seed vessel; *improper* when formed of other parts. In the mulberry and rose, a large fleshy calyx becomes a berry. In the strawberry, a berry is formed of the common receptacle; in the rasp berry, of a seed.

Bacciferus. Bearing berries.

Barb. A straight process, armed with teeth pointing backwards. *Barbatus.* Bearded.

Bark. Coverings of vegetables, consisting of as many layers as the tree has years: a new layer being formed from cambium, or alburnum. The newest layer is *liber.*

Barren. Producing no fruit; containing stamens only.

Baryta, oxide of barium, called an alkaline earth, composed of seventy barium and eight oxygen: it is of a grey color and poisonous.

Benzoin, a poisonous gum of the tree *benzoe*, combination of the resin with *benzoic acid.*

Bi, from bis, signifying *two.*

Bicarbonate, see salts.

Biennial. Living two years; in the second the flower and fruit are pro duced; as in wheat.

Bilabiate. Corolla with two lips.

Binate. Two growing together.

Bipinnate. Twice pinnate

Biternate. Twice ternate; petiole supporting 3 ternate leaves.

Bivalve. Two-valved.

Bolus, a pill rolled and taken; a ball.

Brachilate. Branches opposite, each

pair at right angles with the preceding.

Bract. Floral leaf; a leaf near the flower, different from the other leaves of the plant.

Branchlet. Subdivision of a branch, twig.

Brumales. Plants which blossom in winter.

Bulbs. Called roots; sometimes growing on the stem; bulbs are buds, or winter residence of future plants. Annual plants have no bulbs; they are preserved by seeds.

Caducous. Falling off early; as the calyx of the poppy.

Calcareous. Containing lime; as shells of oysters, etc.

Calyx. Greek, signifying a *flower-cup;* in most plants it encloses and supports the corolla.

Calumella. The central pillar in a capsule or fruit of any kind.

Capillary. Hair-like.

Capitate. Growing in heads.

Capsule. Little chest; kind of hollow seed vessel which becomes dry and opens when ripe.

Cartilage, gristle, tough substance between bones, etc.

Carbonic Acid, a gas formed by the combination of carbon with oxygen, *carbureted,* this gas with hydrogen.

Carbonate, a salt formed by the union of carbonic acid with an earthly or mellatic base; *carboniferous,* partaking of carbon.

Carniverous, eating flesh.

Carpel. Divisions of the fruit. Each carpel generally forms a distinct cell.

Caucasian, derived from or belonging to Caucasus or the Caucasian mountains, where the white Europeans and Americans are supposed to have originated, and hence distinguished from other races of men.

Caulis. Main, herbage-bearing stem of plants.

Cellular. Made up of cells or cavities.

Cerealia. Grain from which bread is made. (From *Ceres,* goddess of corn.)

Chaffy. Made up of short membranous portions, like chaff.

Chlorine, a gas obtained by mixing muriatic acid in a flask with half its weight of powdered per oxide of manganese, and applying moderate heat; it is the best bleaching substance with water.

Chorion. Clear liquor contained in a seed at the time of flowering. After the pollen is received, this liquor becomes a perfect embryo of a new plant.

Chronic, long continued.

Chyle, the white nutritive fluid secreted by the lacteal vessels and conveyed to the blood.

Ciliate. Fringed with parallel hairs.

Cirrose. Bearing tendrils.

Citrate, a salt compound of citric acid, (the acid of lemon or lime juice,) and a base.

Claw. The narrow part by which a petal is inserted.

Cleft. Split, or divided less than half way.

Coagulate, to curdle, turn into a clot. *coagulum,* thick mass, clotted.

Climbing. Ascending by tendrils, as grapes; by leaf-stalks, as the Clematis; by cauline radicles or fibrous roots, as the creeping ivy.

Collinus. Growing on hills.

Coloured. Different from green; in botany, green is not a colour. White in reality is not a colour, but is so called in botany. There are 16 primary and intermediate colours in botany. White is most common in roots, sweet berries, and petals of spring flowers. Black, in roots and seeds. Yellow, in anthers, and petals of compound flowers. Red, in the petals of summer flowers and acid fruits. Blue and violet, in the petals. Green, in leaves and calyx.

Column. The filaments in gynandrous plants united with the style; the whole is a column.

Comparative Physiology, the natural functions of animals or plants as compared with man.

Coma. A tuft of bracts on the top of a spike of flowers. *Comose.* Sessile bracts.

Compound. Made up of similar simple parts.—*flowers* are in the class Syngenesia, having florets with united anthers.

Compound Leaf. When several leaflets, grow on one petiole.—*raceme*—When several racemes grow along the side of a peduncle.—*umbel.* The peduncles subdivided into peduncles of lesser umbels.—*petiole.* Divided leaf stalk.—*peduncle.* Divided flower stalk.

Conchoidal, shell-form.

Constirpated, costive, bound, crowded.

Condiment, seasoning food, a relish.

Congeries, masses of bodies, groups, collections.

Concentric, in layers around a common centre.

Cone. Scaly fruit like that of the pine, a strobilum. *Coniferous*—Bearing cones.

Conjugate. In pairs.

Connate. Opposite, with the bases, united or growing into one, forming the appearance of one leaf. Anthers are sometimes connate.

Convolute. Rolled into a cylindrical form, as leaves in the bud.

Corculum, or *Corcle.* Embryo or miniature of the future plant, found in seeds often between the cotyledons.

Cordate. Heart-shaped, side lobes rounded.

Corolla, or *corol.* (From *corona*, a crown.) Usually enclosing the stamens.

Cortex. (From *corium*, leather, and *tego*, to cover.) The rind or coarse outer bark. *Cortical.* Belonging to the bark.

Cotyledons. (From *kotule*, a cavity.) Seed lobes. Fleshy part of seeds in most plants rising out of the ground and forming the seminal or seed leaves, lobes generally two; very conspicuous in the leguminous seeds; as beans, peas, &c. Cotyledons are externally convex, internally flat, and enclose the embryo or principle of life, which they protect and nourish.

Creeping. Running horizontally; stems are creeping, as also roots.

Crenate. Scalloped; notches on the margin of a leaf pointing towards neither the apex nor base.

Cruciform. (From *crux*, *crucis*, a cross.) Four petals placed like a cross.

Cryptogamous. Plants which have stamens and pistils concealed.

Culinary. Suitable for preparations of food.

Culm or straw. (In Latin *culmus.*) The stem of grasses, Indian corn, sugar-cane, wheat, &c. *Culmiferous.* Having culms.

Cupule. A cup, as in the acorn.

Cuttings, branches or sprigs of trees or plants.

Cuticle. The outside skin of a plant, commonly thin, resembling the scarf or outer skin of animals.

Cylindrical. Circular shaft of nearly equal dimensions.

Deciduous. Falling off in the usual season; opposed to *persistent* and *evergreen*, more durable than *caducous.*

Decomposition. Separation of the chemical elements of bodies.

Decumbent. Leaning upon the ground, the base being erect. Applied to stems, stamens, &c.

Decurrent. When the edges of a leaf run down the stem or stalk.

Decussated. In pairs, crossing each other.

Deflected. Bending down.

Defoliation. Shedding leaves in their proper season.

Dehiscent. Gaping or opening. Most capsules when ripe are dehiscent.

Deltoid. Nearly triangular, as in the leaves of the Lombardy poplar.

Dentate. Toothed; edged with short projections; larger than serrate. *Denticulate.* Minutely toothed.

Denudate. Plants whose flowers appear before the leaves; appearing naked.

Diabetes, a continued and excessive discharge of urine.

Diadelphous. (From *dis*, two. and *adelphia*, brotherhood.) Stamens united in two parcels; flowers mostly papilionaceous; fruit leguminous.

Diagnosis. The characters which distinguish one species of plants from another.

Diantheria. (From *dis*, two and *anther.*) A class of plants having two anthers.

Diclinia. Stamens in one flower, and

pistils in another; on the same plant or on different plants.

Demulcent, softening, molifying.

Diaphoretic, promoting perspiration.

Dicotyledonous. With two cotyledons or seed lobes.

Digitate. Like fingers. When one petiole sends off several leaflets from a single point at its extremity.

Digynia. Having two pistils.

Diœcious. Having staminate and pistillate flowers on different plants.

Disk. The whole surface of a leaf, or top of a compound flower, as opposed to its rays.

Diurnus. Enduring but a day.

Diuretic, promoting urine.

Drupe. Fleshy pericarp, enclosing a stone or nut. *Drupaceous*, Resembling, or bearing drupes.

Dulcis. Sweet. *Dumosus*. Bushy.

Duplex. Double.

Dyspepsia, difficult digestion, desease of digestive organs.

Echinate. Beset with prickles, as a hedge-hog.

Ecostate. Without nerves or ribs.

Edible. Good for food, esculent.

Eflorescentia. *Effloresco*, to bloom. expressive of the time of the year, and month in which every plant blossoms. *Efflorescence* is applied to the powdered substance found on Lichens.

Effoliation. Premature falling off of leaves, by deseases or accidental causes.

Egret or *Aigrette*. Feathery or hairy crown of seeds, as the down of thistles and dandelions.

Elaborate, done with labour, with much care and attention.

Eliminated, released, openend, rejected

Embrocation, fomenting, application, a lotion,

Emarginate. Having a notch at the end, *retuse*.

Embryo. (From *embrao*, to bud forth.) The germ of a plant; corculum.

Emollient. Softening and relaxing to the animal fibre.

Endocarp. Inside skin of a pericarp.

Endogenous. Stems which grow from the centre outwardly, as in monocotyledons.

Ensiform. Sword-form, two-edged, as in the flag and iris.

Entire. Even and whole at the edge.

Epicarp. (*Epi*, upon, and *karpos*, fruit.) Outer skin of the pericarp.

Epidermis. (From *epi*, upon, and *derma*, skin.) Cuticle or outer skin.

Equivalent of the same value or proportions of the same thing in different substances.

Equinoctial, relating or belonging to the equator, the imaginary line 23° either way from a central line around the earth or in the heavens.

Eroded. Appearing as if gnawed at the edge.

Esculent. Eatable.

Evergreen. Remaining green through the year, not deciduous.

Evolution, unfolding, the theory of germination. *Evolve*, to unfold, disentangle.

Exhale, evaporation, to give off vapor, etc.

Exogenous. Stems which grow externally.

Exotic. Plants brought from foreign countries.

Excrete, to eject, throw off. *Excretories*, vessels which excrete.

Exuviæ, the remains, cast off skins or shells of animals.

Factitious. (From *facio*, to make.) Not natural, produced by art.

Families. In Botany a natural union of several genera into groups; sometimes synonymous with Natural Orders.

Farina. (From *far*, corn.) Meal or flour. Glutinous parts of wheat and other seeds, obtained by grinding and sifting. It consists of gluten, starch, mucilage, etc. Polen is also called farina.

Fascicle. A bundle. *Fasciculate*. Collected in bundles.

Febrile, relating to a fever.

Feculent, dreggy, muddiness, or starchy.

Ferns. Cryptogamous plants, with the fruit on the back of the leaves, or in spikes of minute capsules opening transversly.

Fertile. Pistillate, yielding fruit.

Fibre. Thread-like part.

Filtrate, to strain, percolate through a paper.

Filament. Slender thread-like part of the stamen, etc.

Fimbriated. Divided at the edge like fringe.

Fistulous. Hollow or tubular, as the stalk of the onion.

Fleshy. Thick and pulpy.

Flora. The goddess of flowers; descriptions of flowers are called Floras. *Floral* leaf. Bract.

Floret. Little flower; part of a compound flower. *Florist*. One who cultivates flowers.

Flower, (*Flos*.) Formerly applied mostly to the petals. At present a stamen and pistil only form a perfect flower. *Flower-stalk*. Peduncle.

Foliaceous. Leafy.

Foliated, formed like leaves.

Follicle. Seed-vessel opening lengthwise, or on one side only.

Foot-stalk. Used instead of peduncle and petiole.

Friable, easily crumbled or reduced to powder.

Frond. Leaf of cryptogamous plants. *Frondescence*. Time in which a species of plants unfolds its first leaves. *Frondose*. Leafy, or leaf-like.

Fructification, the act of causing fruit; theory of generation.

Fructiferous. Bearing or becoming fruit.

Fungi. Plural of *fungus*, a mushroom.

Fungous. Growing rapidly with a soft texture like the fungi.

Funicle. Stalk which connects the ovule to the ovary.

Fusiform. Spindle-shaped; a root thick at the top and tapering downwards.

Galvanic, relating to galvanism, a fluid like electricity, excited by chemical action by means of an arrangement of copper and zinc plates, between which is a surface of sulphuric acid and water, the whole is called a *galvanic battery*.

Ganglia, enlargements in the course of nerves, sometimes called little brains and having apparently some similar functions in the lowest animals

Galic Acid, obtained from galls and other vegetable astringents, and composed of 7 carbon, 3 hydrogen, and 5 oxygen.

Gemmaceous. Belonging to a bud; the scales of a bud.

Generic name. The name of a genus.

Genus. (Plural, *genera*.) A family of plants agreeing in their flower and fruit. Plants of the same genus are thought to possess similar medicinal properties.

Germ. Lower part of the pistil, afterwards the fruit. *Germination*. Swelling of a seed and the unfolding of its embryo.

Gibbous. Swelled out, commonly on one side.

Gland. An appendage for secretion or exhalation.

Glume. Scales or chaff of grasses, composing the calyx and corolla; the lower ones are the calyx, all others the corolla; each scale, chaff, or husk, is a valve; if but one, the flower is *univalve*, if two, *bivalve*.

Grafting, the process of uniting the branches or buds of separate trees. By inserting these into the bark, the tree thus engrafted upon, becomes the *stock*.

Gramina. Grasses and grass-like plants. Mostly in the class Triandria. *Gramineous*. Grass-like; or *culmiferous*.

Grandiflorus. Having large flowers.

Granular. Formed of, or covered with grains.

Gregarious. In flocks, plants growing in groups.

Gramnivorous, grain or grass eating, feeding on herbs.

Gymnocarpes. (*Gumnos*, naked, and *karpos*, fruit.) Fruits not covered or concealed. *Gymnospermia*. (*Gumnos*, naked, and *sperma*, seed.) Having naked seeds.

Gynandrous. Stamens growing upon the pistil.

Hepatic. Liver-like, belonging to the liver.

Herb. A plant without a woody stem. *Herbaceous*. Not woody. *Herbage*. Every part of a plant except the root and parts of fructification.

Herbarium. Collection of dried plants.
Herbist. One who collects and sells plants.
Hilum. Eye or mark on a seed at the place of its attachment to the seed-vessel.
Holeraceous. Suitable for culinary purposes; derived from *holus*, signifying pot-herbs. A natural order of Linnæus, called *holeraceæ*, including plants used for the table, or in domestic affairs.
Homogeneous, Consisting of the same nature.
Hybernalis. Growing in winter.
Hybrid. A vegetable produced by the mixture of two species: the seeds of hybrids are not fertile.
Hydrate, relating to, or composed in part of water.
Hydrogen, a simple gaseous element in its purest state, but is combined with a very large number of solid and liquid substances; it composes 85 of 100 parts of water.

Imbricated. Lying over, like scales, or shingles of a roof.
Imperfect. Wanting the stamen or pistil.
Incomplete. Flowers destitute of a calyx or corolla.
Incipiency, begining, first state of a thing.
Inorganic, not organized, irregular, without deffinite arrangements of parts.
Indigenous. Native, growing wild in a country. (Some exotics, after a time, spread and appear as if indigenous.)
Infusoria. Microscopic animalculæ, generally found in infusions of dedecayed animal and vegetable matter.
Inflexed. Incurved, bent inwards.
Inflorescence. (From *inflouresco*, to flourish.) The manner in which flowers are connected to the plant by the peduncle, as in the whorl, raceme, etc.
Interruptedly-pinnate. When smaller leafets are interposed among the principal ones.
Intermittents, fevers occuring at intervals.
Involute. Rolled Inwards.
Irritability. Power of being excited so as to produce contraction; belonging to vegetables as well as animals.
Inspisated, thick state of liquids; *inspisate*, to thicken.
Integument, a covering, an envelop.
Interlacing, to intermix, to weave together.
Inanition, emptiness of body, exhaustion.

Jagged. Irregularly divided and subdivided.
Joints. Knots or rings in culms, pods, leaves, etc.

Keel. Under lip of a papilionaceous flower. *Keeled.* Shaped like the keel of a boat.

Labiate. With lips, as in class Dydynamia.
Lactescent. Yielding a juice, usually white like milk, sometimes red, as in the blood-root.
Lacustris. Growing about lakes.
Lamellated. In thin plates. *Lumina.* Broad or flat end of a petal, in distinction from its claw. Expanded part of a leaf. In general, any thin plate or membrane.
Lanceolate. Spear-shaped, narrow, with both ends acute.
Larva. The caterpillar state of an insect.
Leafet. A partial leaf, part of a compound leaf.
Leaf-stalk. Petiole.
Legume. A pod or pericarp, having its seed attached to one side or suture; as the pea and bean. *Leguminous.* Bearing legumes.
Liber. Inner bark of plants. *Ligneous.* Woody. *Lignum.* Wood.
Liliaceous. Corolla with 6 petals, spreading from the base.
Linear. Long and narrow, with parallel sides, as the leaves of grasses.
Lip. The under petal in a labiate corolla.
Locomotive, power of changing place, moving, as in walking, etc.
Lobe. Large division, or distinct portion of a leaf or petal.
Lyrate. Pinnatifid, with a large roundish leafet at the end.
Lymphatics, small vessels in the ani-

mal system, which absorb the lymph or moisture.

Magnesia, one of the earths, having, as with other earths, a metalic base, *magnesium*.

Malic Acid, commonly obtained from apples and other fruit.

Macerate, to steep, make lean.

Maritime. Growing near the sea.

Metalic salts are composed of an acid and metals. See salts.

Medulla. Pith or pulp of vegetables. Centre or heart.

Medullary, like marrow, pulpy, pithy.

Membranous or *Membranaceous*. Very thin and delicate.

Miasma, poisonous particles arising from putrifying substances, etc.

Microscopic, belonging to a microscope, an arrangement of magnifying glasses; to be seen only with the microscope.

Midrib. Middle rib of a leaf, running from the stem to the apex.

Morphia, a vegetable alkali from opium, constituting its narcotic principle; it forms salts with acids, as *nitrate of morphia*, etc.

Molares. Back teeth, grinders.

Monadelphous. Having stamens united in a tube at the base.

Monilliform. Granulate, strung together like beads.

Monocephalous. (From *mono*, one, and *kephale*, head.) Applied to pericarps, which have but one summit, as wheat, while the geum and anemone have as many as they have styles; they are polycephalous.

Monocotyledonous. Having but one cotyledon.

Monœcious. Having pistillate and staminate flowers on the same plant.

Monopetalous. The corolla in one piece.

Monophyllous. Consisting of one leaf.

Monocepalous. A calyx of one leaf or sepal.

Monospermus. One seed to a flower.

Montanus. Growing on mountains.

Mosses. The second order of the class Cryptogamia.

Mucous, slime, thick tenacious substance of membranes. *Mucilage*, gum. *Mucilaginous*, partaking of gum, etc.

Multiflorus. Many-flowered.

Narcotic. (From *narco*, to stupify.) Having the power of procuring sleep, as opium.

Natural character. That which is apparent, without reference to any particular method of classification.

Neutralize, to make indifferent, to destroy bad qualities. *Neutral compounds*. See salts.

Nectary. (From *nectar*, the fabled drink of the gods.) The part of a flower which produces honey.

Nitrogen or *azote*, a simple elementary substance, usually combined in the formation of solids and liquids, but is found in its gaseous state in the composition of the atmosphere, of which it composes 71 of the 100 parts.

Nitre, a salt formed of nitric acid, (aquafortis,) and potash, commonly called *sult-petre*. *Nitrates* are thus formed of this acid and any other base.

Nucleus. Nut, or kernel.

Obovate. Ovate with the narrower end towards the stem, or place of insertion.

Obtuse. Blunt, rounded, not acute.

Officinalis. Such plants as are kept for sale as medicinal, or for use in the arts.

Opposite. Standing against each other on opposite sides of the stem.

Orbicular. Circular.

Organism, the state of organization, the organs of a body, organic structure.

Ovary. Germ, egg, part impregnated.

Ovate. Egg-shaped, oval with the lower end largest.

Oviparous. Animals produced from eggs, as birds, &c. *Ovum*, an egg.

Ovules. Little eggs: rudiments of fruit or seeds before its fertilization.

Oleagenous, oily, like oil, *oleous*.

Omnivorous, all-devouring, eating animal and vegetable food.

Oxalic acid, a compound of the juice of sorrel, &c. and oxygen; this acid combined with any base, forms *oxalates*.

Oxide, a compound of oxygen with another substance, as any of the metals

in such proportions as not to form an acid; as the oxide (rust) of iron.

Oxygen, a simple gaseous element in its free state, but entering largely into the composition of various solids and liquids; it composes 28 of 100 parts of atmospheric air and 85 of 100 of water.

Palmate. Hand-shaped; resembling the hand with the fingers spread.

Palustris. Growing in swamps and marshes.

Panicle. A loose, irregular bunch of flowers with subdivided branches, as the oat. *Panicled.* Bearing panicles.

Papilionaceous. Butterfly-shaped,—an irregular corolla of four petals; the upper one is the *banner*, the two side ones *wings*, and the lower one the *keel*, as the pea. Mostly in the class Diadelphia.

Papillose. Covered with protuberances.

Pappus. The down of seeds, as the dandelion; a feathery appendage.

Parisitic. Growing on another plant and deriving nourishment from it.

Parenchyma. A succulent or cellular vegetable substance; the thick part of leaves between the opposite surfaces; pulpy part of fruits, as in the apple, &c.

Partition. The membrane which divides pericarps into cells, called the *dissepiment.*

Parted. Deeply divided; more than cleft.

Pathology, relating to diseases, the diseased condition of a body in contradistinction to the healthy state.

Pectinate. Like the teeth of a comb, between fimbriate and pinnatifid.

Pedicel, A little flower-stalk, or partial peduncle.

Peduncle. A stem bearing the flower and fruit.

Pellicle. Thin membranous coat.

Pendent. Hanging down, pendulous.

Perennial. Lasting more than two years.

Perfoliate. Having a stem running through the leaf; differing from connate in not consisting of two leaves.

Perianth. (From *peri*, around, and *anthos*, flower.) A sort of calyx.

Pericarp. (From *peri*, around, and *karpos*, fruit.) A seed vessel or whatever contains the seed.

Perigynous. From *peri*, around, and *gynia*, pistil.

Persistent. Not falling off. Permanent.

Petal. The leaf of a corolla, usually colored.

Petiole. The stalk which supports the leaf.

Phenogamous. Such flowers as have stamens and pistils visible, including all plants except the cryptogamous.

Physiology. A knowledge of nature; natural functions of organized bodies.

Pinnate. A leaf is pinnate when the leafets are arranged in two rows on the side of a common petiole, as in the rose. *Pinnatifid.* Cut in a pinnate manner. It differs from pinnate, in being a simple leaf deeply parted, while pinnate is a compound of distinct leafets.

Pistil. Central organ of most flowers, consisting of germ, style, and stigma.

Pistillate. Having pistils but no stamens.

Pith. Spongy substance in the centre of stems and roots. Medulla.

Placenta. The internal part of the germ or ovary to which every ovule is attached, immediately or by the funicle, as in the womb.

Plumose. Feather-like. *Pumula* or *Plume.* Ascending part of a plant at its first germination.

Pod. Dry seed-vessel, not pulpy, commonly applied to legumes and siliques.

Polyandrous. Having many stamens inserted upon the receptacle.

Polygamous. Having some flowers perfect, and others with stamens only, or pistils only.

Polymorphous. Changeable, assuming many forms.

Polypetalous. Having many petals.

Polyphyllous. Having many leaves.

Polysepalous. A calyx of more than one leaf, or sepal.

Pome. A pulpy fruit, containing a capsule, as the apple.

Pratensis. Growing in meadow land.
Process. A projecting part.
Pubescent. Hairy, downy, or woolly.
Pulp. Juicy, cellular substance of berries and other fruits.
Punctate. Appearing dotted. Perforated.
Petalous, leafy; *petaloid*, like a leaf.
Putrescent, rotten, putrid, decaying.
Prophylactic, preventative against desease.
Proximate, next, near, intimate.
Phosphate, a salt composed of phosphoric acid (Phosphorus and oxygen) and an earthy base, as phosphate of lime.
Potash, a fixed alkali from the ashes of plants having a metalic base, potassium.
Physical, relating to or effected by natural agents, material objects or means.

Raceme. A bunch or cluster, kind of infloresence in which the flowers are arranged by simple pedicels on the sides of a common peduncle; as the currant.
Rachis. The common stalk to which the florets and spikelets of grasses are attached; as in wheat heads.—The midrib of some leaves and fronds.
Radiate. The ligulate florets around the margin of a compound flower.
Radix. A root; part of the plant attracting moisture from the soil.
Radical. Growing from the root.
Radicle. Part of the corculum which forms the root; the minute fibres of a root.
Ramiferous. Producing branches.—*Ramose.* Branching. *Ramus.* A branch.
Ray. The outer margin of compound flowers.
Receptacle. The end of a flower-stalk: the base to which the different parts of fructification are usually attached.
Reflexed. Bent backwards.
Reclined. Bending over with the head inclined towards the ground.
Regimen, diet in sickness.
Reniform. Kidney-shaped, heart-shaped without the point.
Residuum. What is left after experiment or distribution.
Reticulate. Veins crossing each other like net-work.
Ringent. Gaping or grinning; applied to some labiate corollas.
Rootlet. A fibre of a root, little root.
Rotate. Wheel-form.
Rudimentary, first or early forms or principles.

Saccharine, partaking of or having the quality of sugar.
Saline, partaking of salt, belonging to places where salt is found.
Saltiferous. Bearing or producing salt.
Salts, in chemistry, substances composed of an acid and a base, as *chloride of sodium*, (common salt); when salts do not color infusions of litmus, etc., they are *neutral salts*, when they do, they are *acidulous;* and *super* or *bi* denotes the excess of acid, and when the acid is dificient or the alkaline base predominates, *sub* is added. There are great numbers of these salts.
Saponaceous, soapy, like soap or thick oil.
Sarmentose. Running on the ground, and striking root from the joints only, as the strawberry.
Scape. A stalk which springs from the root, and supports flowers and fruit but no leaves, as the dandelion.
Scions. Shoots proceeding laterally from the roots or bulb of a root.
Secrete. To seperate, collect, withdraw from. *Secretories.* The vessels which secrete.
Segment. Part or principal division of a leaf, calyx, or corolla.
Sepal. Leaves or divisions of the calyx.
Septa. Partitions that divide the interior of the fruit.
Serrate. Notched like the teeth of a saw.
Sessile. Sitting down; placed immediately on the main stem without a foot-stalk. *Setaceous.* Bristle-form. *Setose.* Covered with bristles.
Sheath. A tubular or folded leafy portion including within it the stem.
Shoot. Trees and shrubs send forth annually a large shoot in the spring and a smaller one from the end of that in June.

Shrub. Plant with a woody stem, branching nearer the ground than a tree, and smaller.

Silique. A long pod or seed-vessel of two valves, having the seed attached to the two edges alternately.

Silex or *silica*, an earth, consisting of oxygen and a metalic base; *silicon*, quartz, flint.

Silicate. a salt formed of silex or flint and an acid.

Soluble, capable of being dissolved in liquids, etc.

Spadix. Elongated receptacle of flowers, commonly from a spatha.

Spatha. A sheathing calyx opening lengthwise on one side, with one or more valves.

Spatulate. Large, obtuse at the end, gradually tapering into a stalk at the base.

Specific. Belonging to a species only.

Spike. A kind of inflorescence in which the flowers are sessile, or nearly so, as in the mullein, or wheat. *Spikelet.* A small spike.

Spindle-shaped. Thick at top, gradually tapering, fusiform.

Spine. A thorn or sharp process growing from the wood. *Spinescent.* Bearing spines or thorns. *Spinosus.* Thorny.

Spiral. Twisted like a screw.

Sporules. That part in cryptogamous plants which answers to seeds.

Stamen. The part of the flower on which the artificial classes are founded.

Staminate. Having stamens without pistils.

Stellate. Like a star.

Stigma. The summit, or top of the pistil.

Stipe. The stem of a fern, or fungus, also the stem of the down of seeds, as in the dandelion.

Stipule. A leafy appendage at the base of petioles, or leaves.

Strigose. Armed with close thick bristles.

Strobilum. A cone, an ament with woody scales.

Stomachic, relating to or good for the stomach, tonic.

Stomates, pores, small holes.

Style. The part of the pistil between the stigma and the germ.

Subulate. Awl-shaped, narrow and sharp pointed.

Succulent. Juicy; also a pulpy leaf, juicy or not.

Sucker. A shoot from the root by which the plant may be propagated.

Sulphate, a salt composed of sulphuric acid, (oil of vitriol,) and any solid base, as sulphate of soda, (Glauber's salts,) etc.

Superior. A calyx or corolla is superior, when it proceeds from the upper part of the germ.

Suture. Line or seam formed by the junction of two valves of a seed-vessel.

Sylvestris. Growing in woods.

Syngenesious. Anthers growing together, forming a tube; constituting the class Syngenesia, being also compound flowers.

Synthetical, joining, uniting, compounding.

Tartrate, a salt formed of tartaric acid and a base, usually *potash* in vegetables, as the tartrate of potash.

Tannin, an astringent principle of plants, etc.

Tegument. The skin or covering of seeds; as in the pea.

Temperature. Degree of heat and cold to which any place or substance is subject, as dependant upon latitude. The mountains of the torrid zone produce the plants of the frigid zone. In cold regions white and blue petals are most common; in warm regions red and other bright colors; in the spring we have more white petals, and in autumn more yellow ones.

Tendril. A filiform or thread-like appendage of some climbing plants, supported by twining round objects.

Terminal. Extreme, situated at the end.

Ternate. Three together, as the leaves of the clover.

Tetradynamous. With four long and two short stamens. *Tetrandrous.* Having four stamens.

Tissue, thin fabric or envelop composed of or interwoven with small fibres.

Tomentose. Downy; covered with fine matted pubescence.

Topical, local, confined to a place.
Torrid, very hot, parched.
Trituration, rubbing to powder, pulverizing.
Trifid. Three-cleft. *Trifoliate*. Three-leaved. *Trilobate*. Three-lobed. *Trilocular*. Three-celled.
Truncate. Having a square termination, as if cut off.
Trunk. The stem or bole of a tree.
Tube. Lower hollow cylinder of a monopetalous corolla.
Tuber. A solid fleshy knob. *Tuberous*. Thick and fleshy, containing tubers, as the potato.
Tunicate. Coated with surrounding layers, as in the onion.

Ultimate, last, final.
Umbel. A kind of inflorescence in which the flower-stalks diverge from a centre, like the sticks of an umbrella. *Umbelliferons*. Bearing umbels.
Uniflorus. One-flowered. *Unicus*. Single.

Vascular, composed of vessels.
Valves. Parts of a seed-vessel into which it separates; the leaves which form a glume, or spatha.
Volatile, flying off, evaporating, distinguished from *fixed* or *permanent*.
Variety. Subdivision of a species, distinguished by characters not permanent.
Vernal. Appearing in the springs.
Verrucose. Warty, covered with protuberances,
Verticillate. Whorled, having leaves or flowers in a circle round the stem.
Vesicular. Made up of cellular substance.
Villose. Hairy, the hairs long and soft.
Virose. Nauseous to the smell, poisonous.
Viscid. Thick, glutinous, covered with adhesive moisture.
Volatile, flying off, evaporating, distinguished from *fixed* or *permanent*.

Wings. Two side petals of a papilionaceous flower.

Zoophytes. Lowest order of animals, sometimes called animal plants though considered as belonging to the animal kingdom. Many resemble plants, and exhibit faint marks of sensation.

GLOSSARY.

FOR THE SECOND PART.

Absorbent. A vessel which sucks up liquids.

Abrupt. Pinnate leaf, with an old or terminal leafet.

Acuminate. Taper-pointed, the point mostly curved towards one edge of the leaf, like an awl.

Acrid. Having a hot, biting, or bitter tast.

Acidulous. Sour, partaking of an acid.

Adjuvant. Helpful, assistant.

Agamous. (From *a*, without, and *gamos*, marriage.)

Ages of plants. *Ephermeral*, such as spring up, blossom and ripen their seed in a few hours or days; *annual*, living a few months, or one summer; *biennial*, springing up one summer and dying the following; *perennial*, living an indefinite period.

Aggregate. Many springing from the same point—*aggregate*, *compound*, *umbellate*, *cymose*, *amentaceous*, *glumose*, *spadiceous*.

Aggregate flower; erected on footstalks; all have one common receptacle on the stem.

Alburnum. (From *albus*, white.) Soft white substance in trees between the liber, or inner bark and wood. It is the *sap-wood*, formed by a deposit of the *cambium*, or descending sap; in one year it becomes wood; and a new layer of alburnum is again formed.

Albumen. The farinacous part secreted in most monocotyledonous seeds or fruits, between the embryo and outer skin, furnishing the flower chiefly of the corn plants, and composed of similar chemical characters with the albumen of animals: it is never poisonous, though the plants may be.

Algæ. Flags: plants of the order *Hepaticæ* and *Lichens*.

Alternate. Branches, leaves, flowers, etc., beginning at different distances on the stem; *opposite*, is when they commence at the same point, base standing against base.

Alternately-pinnate leaf; when leafets are arranged alternately on each side of the common footstalk or petiole.

Anthilminthic. Destructive to worms.

Amonia. A volatile alkali existing chiefly combined with acids and forming salts: in the form of gas, its pure state, it is composed of nitrogen and hydrogen.

Animal Charcoal is commonly prepared by boiling the refuse of slaughter-houses and mixing it with sifted coal ashes.

Analysis. (Botanically) To ascertain the name, by observing the organs, and comparing them with scientific descriptions of plants; separation of parts.

Annual. A plant living but one year. The herbage is often annual, while the root is perennial; the plant is then *perennial*.

Anomalous. (From *a* without, and *nomos*, law.) Irregular, whatever forms an exception to a general rule.

Anther. (From *anthos*, a flower) part of the stamen which contains the pollen; it is of various forms.

Antiscorbutic. Curing eruptions or scurvy.

Antiseptic. Preventive of putrifaction.

Antispasmodic. Good for relieving spasms.

Aperient. Having the quality of opening.

Aphrodisiacal. Relating to, or a cure for the venereal disease.

Aquatic. (From *aqua*, water.) Growing in, or near water.

Arenarius. Growing in sand. *Arid.* dry.

Aromatic. Sweet-scented.

Aroma. Odor, purfume.

Astringents. Substances which condense the fibres.

Assimilation. The act by which organized bodies incorporate foreign substances and convert them into their own substance.

Atonic. Relaxing to the body.
Awn. A short stiff bristle.
Axillary. Growing out of the axils; leaves are axillary when they proceed from the angle formed by the stem and branch.
Axis. The elongated part of a petiole, on which are many flowers. A centre.

Bark. Coverings of vegetables, consisting of as many layers as the tree has years: a new layer being formed from cambium, or alburnum. The newest layer is *liber*.
Biennial. Living two years; in the second the flower and fruit are produced; as in wheat.
Bolus. A pill rolled and taken, a ball.
Bulbs. Called roots; sometimes growing on the stem; bulbs are buds, or winter residences of future plants. Annual plants have no bulbs; they are preserved by seeds.

Calcareous. Containing lime; as shells of oysters, etc.
Calyx. (Greek) signifying a *flowercup;* in most plants it encloses and supports the corolla.
Capillary. Hair-like.
Capsule. Little chest; kind of hollow seed vessel which becomes dry and opens when ripe.
Cardate. Heart-shaped, side lobes rounded.
Cardiac. Superior opening of the stomach; belonging to the heart.
Carbonic Acid. A gas formed by the combination of carbon with oxygen, *Carbureted hydrogen,* carbon with hydrogen. *Carminative.* A medicine used to dispel wind.
Cataplasm. A poultice, soft plaster.
Cellular. Made up of cells or cavities.
Cerealia. Grain from which bread is made. (From *Ceres,* goddess of corn.)
Chaffy. Made up of short membranous portions, like chaff.
Chronic. Long continued.
Chyle. The white nutritive fluid secreted by the lacteal vessels and conveyed to the blood.
Claw. The narrow part by which a petal is inserted.
Climbing. Ascending by tendrils, as grapes; by leaf stalks, as the Clematis, by cauline radicles or fibrous roots, as the creeping ivy.
Cleft. Split, or divided less than half way.
Coherent. Sticking together, adhering.
Collinus. Growing on hills.
Coloured. Different from green; in botany, green is not a colour. White in reality is not a colour, but is so called in botany. There are 16 primary and intermediate colours in botany White is most common in roots, sweet berries, and petals of spring flowers. Black, in roots and seeds. Yellow, in anthers, and petals of compound flowers. Red, in the petals of summer flowers and acid fruits. Blue and violet, in the petals. Green, in leaves and calyxes.
Compound. Made up of similar simple parts.—*Flowers* are in the class Syngenesia, having florets with united anthers.
Concentric. In layers around a common centre.
Constirpated. Costive, bound, crowded.
Condiment. Seasoning food, a relish.
Connate. Opposite, with the bases, united or growing into one, forming the appearance of one leaf. Anthers are sometimes connate.
Convolute. Rolled into a cylindrical form, as leaves in the bud.
Corolla, or *corol.* (From *corona,* a crown.) Usually enclosing the stamens.
Crisp. Brittle, curled.
Crenate. Scalloped; notches on the margin of a leaf pointing towards neither the apex nor base.
Cryptogumous. Plants which have stamens and pistils concealed.
Culinary. Suitable for preparations of food.
Cuticle. The outside skin of a plant, commonly thin, resembling the scarf or outer skin of animals.
Cuttings, branches or sprigs of trees or plants.
Cylindrical. Circular shaft of nearly equal dimensions.

Deciduous. Falling off in the usual season; opposed to *persistent* and *evergreen;* more durable than *caducous.*

Decomposition. Separation of the chemical elements of bodies.
Decurrent. When the edges of a leaf run down the stem or stalk.
Demulcent, softening, molifying.
Dehiscent. Gaping or opening. Most capsules when ripe are dehiscent.
Deobstruent. Removing obstructions.
Dentate. Toothed; edged with short projections; larger than serrate.
Denticulate. Minutely toothed.
Disk. The whole surface of a leaf, or top of a compound flower, as opposed to its rays.
Diaphoretic. Promoting perspiration.
Diuretic. Promoting urine.
Dyspepsia. Difficult digestion, desease of digestive organs.

Edible. Good for food, esculent.
Elaborate. To do with labour, with much care and attention.
Embryo. (From *embrao,* to bud forth.) The germ of a plant; corculum.
Emollient. Softening and relaxing to the animal fibre.
Entire. Even and whole at the edge.
Endogenous. Stems which grow from the centre outwardly, as in monocotyledons.
Esculent. Eatable.
Evergreen. Remaining green through the year, not deciduous.
Exogenous. Stems which grow externally.
Exotic. Plants brought from foreign countries.
Excrete. To eject, throw off. *Excretories,* vessels which excrete.
Expectorant. (From *expectoro,* to discharge from the breast.) Promoting a discharge from the lungs.
Exuviæ. Remains, cast off skins or shells of animals.

Families. In Botany a natural union of several genera into groups; sometimes synonymous with Natural Orders.
Farina. (From *far,* corn.) Meal or flour. Glutinous parts of wheat and other seeds, obtained by grinding and sifting. It consists of gluten, starch, mucilage, etc. Polen is also called farina.
Febrile, relating to a fever.
Febrifuge. (From *febris,* a fever, and *fugo,* to drive away.) Possessing the property of abating a fever.
Feculent. Dreggy, muddiness, or starchy.
Ferns. Cryptogamous plants, with the fruit on the back of the leaves, or in spikes of minute capsules opening transversly.
Fibre. Thread-like part.
Filtrate. To strain, to percolate through paper.
Fleshy. Thick and pulpy.
Floret. Little flower; part of a compound flower. *Florist.* One who cultivates flowers.
Foliated. Formed like leaves.
Friable. Easily crumbled or reduced to powder.
Fungi. Plural of *fungus,* a mushroom.

Gangrene. Mortification, putrefaction.
Generic name. The name of a genus.
Genus. (Plural, *genera.*) A family of plants agreeing in their flower and fruit. Plants of the same genus are thought to possess similar medicinal properties.
Germ. Lower part of the pistil afterwards the fruit. *Germination.* Swelling of a seed and unfolding of its embryo.
Glaucous. Sea-green, mealy, and easily rubbed off.
Gonorrhœa. Morbid venereal discharge
Granular. Formed of, or covered with grains.
Graveolens. Having a strong odor.

Hemorrhage. Violent flux of blood.
Hepatic. Liver-like. belonging to the liver.
Herb. A plant without a woody stem.
Herbage. Every part of the plant except the root and parts of fructification.

Intermittents. Fevers occurring at intervals.
Iodine. A soft substance obtained from ashes from sea-weed; it is the most delicate test for starch, etc.
Incisors. Front teeth.
Indigenous. Native, growing wild in a country. Some exotics, after a time, spread and appear as if indigenous.
Indurated. Becoming hard.

Iridescent. (From *Iris*, the rainbow.) Reflecting colored light.

Jagged. Irregularly divided and subdivided.

Labiate. With lips, as in class Didynamia.
Lamellated. In thin plates. *Lamina.* Broad or flat end of a petal, in distinction from its claw. Expanded part of a leaf. In general, any thin plate or membrane.
Lanceolate. Spear-shaped, narrow, with both ends acute.
Larva. The caterpillar state of an insect.
Leafet. A partial leaf, part of a compound leaf.
Leaf-stalk. Petiole.
Legume. A pod or pericarp, having its seeds attached to one side or suture; as the pea and bean.
Ligneous. Partaking of wood, woodlike.
Ligulate. Strap or riband-like, flat, as the florets of the dandelion.
Linear Long and narrow, with parallel sides, as the leaves of grasses.
Lobe. Large division, or distinct portion of a leaf or petal.
Lyrate. Pinnatifid, with a large roundish leafet at the end.

Marmalade. Quince and other fruit-juice with sugar.
Masticatory. A medicine to be chewed.
Medulla. Pith or pulp of vegetables. Centre or heart.
Morbid. Diseased, inactive, corrupted, without life.

Narcotic. (From *narco*, to stupify.) Having the power of procuring sleep, as Opium.
Niger. Black.

Officinalis. Such plants as are kept for sale as medicinal, or of use in the arts.
Oleaginous. Oily, unctuous.
Orbicular. Circular.
Organism. The state of organization, the organs of a body, organic structure.
Ovate. Egg-shaped, oval with the lower end largest.
Oxide. A compound of oxygen with another substance, as any of the metals in such proportions as not to form an acid, as the oxide (rust) of iron.
Oxygen. A simple gaseous element in its free state, but entering largely into the composition of various solids and liquids; it composes 28 of 100 parts of atmospheric air and 85 of 100 of water.

Palmate. Hand-shaped; resembling the hand with the fingers spread.
Panicle. A loose, irregular bunch of flowers with subdivided branches, as the oat. *Panicled.* Bearing panicles.
Panification. Capable of being moulded into bread in pans.
Parisitic. Growing on another plant and deriving nourishment from it.
Parenchyma. A succulent or cellular vegetable substance; the thick part of leaves between the opposite surfaces; pulpy part of fruits, as in the apple, &c.
Petalous. Leafy. *Petaloid.* Like a leaf.
Pectinate. Like the teeth of a comb, between fimbriate and pinnatifid.
Peduncle. A stem bearing the flower and fruit.
Perennial. Lasting more than two years.
Petal. The leaf of a corolla, usually colored.
Petiole. The stalk which supports the leaf.
Phosphate, a salt composed of phosphoric acid (Phosphorous and oxygen) and an earthy base, as phosphate of lime.
Physiology. A knowledge of nature; natural functions of organized bodies.
Phlegmatic. Sluggish, dull, troubled with phlegm.
Pinnate. A leaf is pinnate when the leafets are arranged in two rows on the side of a common petiole, as in the rose. *Pinnatifid.* Cut in a pinnate manner. It differs from pinnate in being a simple leaf deeply

parted, while pinnate is a compound, of distinct leafets.

Pith. Spongy substance in the centre of stems and roots. Medulla.

Potash, a fixed alkali from the ashes of plants having a metalic base, potassium.

Proximate, next, near, intimate.

Pratensis. Growing in meadow land.

Pulp. Juicy, cellular substance of berries and other fruits.

Pungent. Sharp, acrid, piercing.

Putrescent, rotten, putrid, decaying.

Rationale. Reason, conclusion.

Refrigerants. From *refrigero*, to cool. Cooling medicines or drinks.

Residuum. What is lett after experiment or distribution.

Resolvent. Having the power to dissolve or analyze.

Regimen, diet in sickness.

Rubefacient. Substances which, applied to the skin, produce redness without blistering.

Saltiferous. Bearing or producing salt.

Salts, in chemistry, substances composed of an acid and a base, as *chloride of sodium*, (common salt); when salts do not color infusions of litmus, etc., they are *neutral salts*, when they do, they are *acidulous*; and *super* or *bi* denotes the excess of acid, and when the acid is dificient or the alkaline base predominates, *sub* is added. There are great numbers of these salts.

Saline, partaking of salt, belonging to places where salt is found.

Saccharine, partaking of or having the quality of sugar.

Sedative. Assuaging, composing, diminishing the natural energy.

Segment. Part or principal division of a leaf, calyx, or corolla.

Sepal. Leaves or divisions of the calyx.

Sessile. Sitting down; placed immediately on the main stem without a foot-stalk.

Setaceous. Bristle-form. *Setose.* Covered with bristles.

Shrub. Plant with a woody stem, branching nearer the ground than a tree and smaller.

Silique. A long pod or seed-vessel of two valves, having the seed attached to the two edges alternately.

Soluble, capable of being dissolved in liquids, etc.

Soporific. Causing sleep.

Spindle-shaped. Thick at top, gradually tapering, fusiform.

Spine. A thorn or sharp process growing from the wood. *Spinescent.* Bearing spines or thorns. *Spinosus.* Thorny.

Spurred-rye. A morbid swelling of the seed, of a black or dark color, sometimes called ergot; the black is called malignant ergot. Grain in low, moist ground, or new land, is most subject to it.

Striate. Marked with fine parallel lines.

Stamen The part of the flower on which the artificial classes are founded.

Stipe. The stem of a fern, or fungus, also the stem of the down of seeds, as in the dandelion.

Succulent. Juicy; also a pulpy leaf, juicy or not.

Sucker. A shoot from the root by which the plant may be propagated.

Supuration. The formation of pus or morbid matter in abscesses, sores, etc.

Sudorific. Promoting or causing sweat.

Tannin. An astringent principle of plants, etc.

Topical. Local, confined to a place.

Tonic. From *tono* to strengthen. Medicines which increase the tone of the muscular fibre.

Torrid. Very hot, parched.

Trituration. Rubbing to powder, pulverizing.

Ultimate. Last, final.

Umbel. A kind of inflorescence in which the flower-stalks diverge from a centre, like the sticks of an umbrella. *Umbelliferous.* Bearing umbels.

Volatile. Flying off, evaporating, distinguished from *fixed* or *permanent.*

Vermifuge. A medicine for the cure of worms.

Vesication. Blistering the skin.
Vicera. The bowels, organs of the chest, etc.
Viridis. Green.
Virose. Nauseous to the smell, poisonous.
Zoophytes. Lowest order of animals, sometimes called animal plants though considered as belonging to the animal kingdom. Many resemble plants, and exhibit faint marks of sensation.

PART I.

ELEMENTS AND OUTLINES

OF

VEGETABLE PHYSIOLOGY.

Vegetable Organic Chemistry,	Geography of Plants,
Vegetable Organs,	Effects of Climate on Plants,
Botanical Classification,	American Plants and Forests.

Sketch of the Divisions and History of the Subject.

A knowledge of plants, or vegetables, consists in an acquaintance, 1st, with their external forms and appearances, and 2d, with their internal structure and organic action. The former comprehends *botany*, and requires a careful observation and study of the peculiarities of plants, with an extensive knowledge of terminology. The latter requires an investigation into the anatomy and functions of the organs, and an analysis of the component parts of plants. This may be denominated *vegetable physiology*, or *vegetable organic chemistry*. There may be a 3d division, consisting of a practical knowledge of the modes of cultivating plants, and also of their qualities and uses, which belongs properly, to *gardening* and *horticulture*.

The great variety of plants has rendered their systematic arrangement into *classes*, *orders*, *genera*, *species* and *varieties*, a somewhat difficult task. The processes, also, of determining the internal organization and vital action of plants, with the phenomina of assimilation, have likewise been a task of much labor and scientific research. Still, as few subjects possess equal interest, or are more attractive, a knowledge, both of the nature and classification of plants, has rapidly advanced, of late; so that either may now be known with comparatively little time or labor. The want of this knowledge must have been long and painfully felt by mankind, as it has been only within a few years that a systematic arrangement and philosophic investigation have determined the character and useful properties of plants, and

rendered their study and cultivation so important and agreeable as they now are.

Scarcely 1,500 *plants* were known from the descriptions of the ancients at the time of the revival of letters; whereas more than 56,000 *species* are now known, arranged and described. A perfect chaos must have existed in the vegetable kingdom before the labor of scientific men began to display the order by which it is characterized. As it was at first obvious that the production of seeds was the great object of vegetation, attempts were made to classify plants by them; but their uniformity not corresponding with the diversified character of plants, other organs were resorted to for this purpose. The flower was therefore, thought to present the best means of classification; yet the absence of flowers in numerous plants, with other limits, soon made it necessary for the principal founder of the science of botany, (Linnæus), to confine his arrangement to the sexual parts of the flower. The principle was thereupon established which at once led the way to the great *Linnœan system.*

Plants were divided into two *divisions*, one having *visible* sexual organs, *(phenogamous)*, and the other *invisible* sexes, or wanting those organs, *(cryptogamous.)* The first comprehends the first 23 *classes* of the system, according to the situation of the sexual parts. But objections have been urged against parts of this system by succeeding botanists, and other organs have been considered as necessary, as well as other methods, to complete the arrangement. The second division is based on the anatomy of plants, and may be called *chemical botany.* It leads to a knowledge of the laws of vegetative life, their physiology, or physiological botany, which is analogous with the physiology of animals. On this is based a knowledge of the diseases or deformities of plants, or their *pathology*, which is of great importance in their cultivation, and also in their general distribution, or *vegetable geography.*

The history of vegetable science is brief and imperfect. The Greek philosophers having derived their knowledge principally from Asia and Egypt, examined the laws of vegetable life very superficially, from their want of means and their ignorance of chemistry. They at once arrived at general conclusions and asserted that plants possessed rational souls, capable of the mental powers and indicative of the organization of animals. Aristotle, 384 B. C. published his works on natural history, in which he formed a more rational theory, though little corresponding with that of the present day. Theophrastus, the pupil of Aristotle, is said to have been the founder of philosophical botany; he wrote several works on the subject. Dioscorides compiled a work containing a partial description, particularly of the medicinal qualities of 1,200 plants, in the first year of the Christian era; and this was the only source of botanical knowledge for *fifteen centuries.* To this, Persian and Arabian physicians added 200 plants.

The elder Pliny and Galen contributed also to a knowledge of the properties of plants. But the Germans were first to found historical botany and to commence scientific classification. The Italians followed, and then the Belgians. The French greatly increased the number of plants and reformed the nomenclature; so that, at the beginning of the 17th century, the number of species known was 5,500. This number continued to increase, by an awakened attention to the subject and the united labors of others in various countries, until Linnæus appeared with his *Species Plantarum*, when the number of plants known was 7,300. Since this time it has increased most wonderfully. A more systematic, or *natural method* of arrangement has been introduced by Jussieu, Condolle, Mirbel and others, and the whole now presents in every department the most attractive interest. The progress of the science of vegetables, botanical and agricultural, has been unexampled in the history of any other science. But however interesting this may be, we lack time and space to notice it further. Chemistry, the chief source of improvement in this branch of science, has recently disclosed, through Liebeg and others, the most important facts, as to the nature, requirements and properties of fruits and plants, and shed a noon-day light in the path of the practical agriculturist. By this we have been governed in our expositions of the several branches of the subjects hereafter treated. We will not, therefore, go back to show how little has been known but briefly present what is now known of these subjects.

Of fruits, their great variety and useful properties, comparatively little could have been known before commerce, in the 15th and 16th centuries, conveyed those of one country to the people of another. They had, from the earliest periods, constituted a chief article of human food; and now, as we shall see, they are at once the most important, luxurious and wholesome aliment, as well as the most valuable for many other very important purposes in life. Constituting an essential part of vegetables, the scientific history of fruits is connected with the plants which bear them, though they were much earlier used and valued by man, as they contributed immediately to his existence. The modes in which they may be used both for food and drinks, and in the arts have increased with the progress of science and civilization. The rich products of the tropical climates are now transported to every other clime, and the use of our own has been refined by every art of genius and luxury.

Garden Plants have received attention corresponding with the progress of agricultural science and civilization. This branch of our subject, therefore, has advanced rapidly within comparatively a few years. Luxury has fortunately contributed greatly to the developement of the most valuable properties of garden productions, which are now everywhere, and justly esteemed, not only as the most grateful,

but the most wholesome food. Refined modes of cooking as well as the truths of science, have happily changed the tastes of civilized people and induced the cultivation and consumption of a greater variety and number of vegetables; while they have, at the same time, diverted the taste and attention from the undue consumption of flesh. That this has added to the health and longevity of mankind there can be no doubt, though neither is equal to what it was in earlier periods of society, as a consequence of the then greater comparative consumption of vegetable food. The best interests of man, therefore, demand more attention to the cultivation and use of garden plants. It cannot be long, we trust, before this will be the most *popular*, as it is the most useful, department of knowledge. Appearances indicate that it is even now with us, as it is in parts of Europe, *unfashionable* to be ignorant of the nature and properties of vegetables and fruits; certainly no subject is receiving so much attention among us. While the agriculturist is thus rapidly adding to his practical knowledge, in every part of the country, the inhabitants of our cities, merchants and mechanics, are wisely directing their attention to the subject as a branch of the most valuable and pleasing information. And it is worthy of remark, in this connection, that many of them are becoming at the same time the most profitable agriculturists, from the facilities afforded by the perusal of books.

OUTLINES OF VEGETABLE PHYSIOLOGY.

PLANTS are organized living bodies which, like those of animals, are composed of solids and fluids. They are without powers of locomotion, and, it is thought, of voluntary motion. They are fixed to the earth by roots, from which they rise upward by a stem which throws out branches that in their turn give out others, all bearing leaves, flowers, fruits and seeds. The word plant literally means "fixed or rooted;" but in Botany it signifies all productions of the vegetable kingdom. These are of three kinds—*herbs*, *shrubs* and *trees*; they are *annual*, perishing within the year; *biennial*, flowering the second year and then perishing, or *perennial*, surviving many years. They are *deciduous* when their leaves fade in autumn, and *evergreen* when these are constantly renewed, as with all resinous trees. They are *indigenous*, or native, and *exotic* or foreign. The solid parts of plants consist mostly of *cellular substance*, *woody-fibre*, *pith*, *bark*, etc., and of fluids and juices, of various degrees of consistence, as *volatile* and *fixed oils*, *gums*, *resins*, *air*, *water*, etc. These are circulated in various ways and in numerous vessels and organs, each containing particular substances and performing peculiar functions.

The fluids or juices moving in the vessels of plants contain the nourishment and constitute the essential means by which food is assimilated with their solid substances. A correspondence is thus observable between their functions and the circulation of the blood and other physiological phenomena of animals. They possess powers of motion, irritability, and of reproduction; they breathe, sleep, digest, and perspire. Their peculiar individual character is preserved by their vital functions which constitute their life; and when they cease, their bodies are exposed to the chemical processes which act alike on all inorganic substances, and they die.

"See dying vegetables life sustain;
See life dissolving, vegetate again."

The circulation, or motion of the juices of plants, is thought to be mechanical, the result of their irritability, the vessels acting as capilliary tubes, etc. This irritability is destroyed by shocks of electricity, as with animals. Heat and light greatly increase this circulation, as in the spring of the year, while cold as readily checks or suspends it, as in autumn and winter. Long continued heat and rapidity of circulation, as in summer, exhausts their powers or irritability, till in autumn it is slow and their fluids are thick, as in animal life, both in regard to season and old age. Their repose, too, after the activity of the day, and their revival on the appearance of light, are not less remarkable than with man, or lower animals, under like circumstances.

The breathing of plants is their absorption and exhalations,—physiological facts as notable as any other in the vegetable or animal economy. This is performed by, and is especially observable in the leaves. A plant growing under ice constantly emits bubbles of pure oxygen, which rise to escape. Placed also in a tumbler of water, exposed to the sun, it is soon seen to be covered with air-bubbles, which rise to the surface and burst. The inspiration of carbonic acid through the leaves of plants is as constant, and in quantity still more abundant. By this they live and furnish their organs with nourishment; and, by their expirations during the day they afford the vital gaseous principle, oxygen, which is as necessary to the life of man and the animal world as to that of plants—withdrawing at the same time, carbonic acid, which is most hurtful to animal life. Besides gases, they also exhale liquids which, in a common sized tree, amounts to 30 pounds a day.

Their odor, thus exhaled, consists of *volatile oils* which, in quantity is proportionate to their volatility, their nature, light, heat, etc. *Their taste* depends on like circumstances, the chemical character of their constituents and the nature of the soil.

The color of plants resides in their cellular substance, beneath the scarf skin, or epidermis, and depends on the peculiar functions of their organs, their situation, heat, etc. Green leaves placed in the dark become yellow, and then white. Young leaves grown in the dark, turn from white to yellow, and then to green, on exposure to light. Blossoms raised in the dark, are not materially changed by light. Plants are lighter by combining with oxygen, and darker on parting with it. Completely saturated with it, they become yellow, as with the leaves in autumn; but under other circumstances, when exposed, they turn to green. The light of a lamp and that of the moon produces no sensible difference in effect.

Secretions and excretions are likewise remarkable functions of plants. All that is healthful and nutritive they secrete for their food and development, and all that is baneful and unproductive they reject and excrete through their roots. These, withdraw from the soil its various qualities, which constitute their life, health, and the perfection of their fruit; combining and assimilating all that is essential for these purposes and casting off all that is useless or poisonous; yet that which may be eminently useful, nevertheless, for other plants.

The existence and growth of plants depend, as with animals, on the reception and assimilation of food. A knowledge, therefore, of the *kind* of nutriment they require is of great importance in vegetable physiology, as well as in practical agriculture. A beautiful connection is thus seen between the organic and inorganic kingdoms. Inorganic matter affords food for plants, plants afford food for animals, and both afford food for man. Men and animals require substances that have life and organization; but plants require inanimate and inorganic matter. Both are apparent machines of greater or less complexity, each depending on the other and acting to produce a determinate end.

The changes produced in plants by the assimilation of the various substances of which they are composed, are the results of chemical action and are traceable from the germ to the full-grown plant and fruit. Water and carbon are resolved into their constituent parts, and these enter into new forms and combinations to constitute their solid portions. The hydrogen of the water unites with the carbon, received through the leaves from the air, to form oils, resins, sugar, etc. The oxygen of the water combines with fluids to form acids, etc. and is also given off from the leaves in the form of gas.

The reproduction of plants is by evolution, which in process and effect, is similar to that of animals. They are endowed with organs which distinguish sexes and which are generally observable, but which change after evolution. The *polen* or *farina*, the seminal principle of plants, is contained in vessels called *anthers*. A part of this penetrates the *stigma*, the head of the *pistil*, and is conveyed to the

ovary of particular plants, and there the germ or *ovules* are affected. Both sexes are united in one flower in most plants; in others they are separated, and the former is therefore called a perfect flower, while the latter is called male and female. These last stand on one stem, or are attached to different plants. Evolution is consequently most perfect and most readily effected in the perfect flowers, as they are called, and likewise when the stem has male and female blossoms. But where the two sexes are entirely separated evolution takes place only where the plants are sufficiently near for the polen of one to be carried by the wind, by insects, or by artificial means to the other. Should this not take place, the germ falls off, or the partial fruit is incapable of germination. Glands within the flowers secrete honey and attract insects which powder parts of their body with polen, and when visiting flowers of another kind, they deposite it. In others, it is said also, where perfect flowers of the two sexes are not near, small flies, being attracted by the honey of one flower, are suddenly enclosed by it and, in their endeavors to escape, necessarily deposite the polen obtained from other flowers. On this system of sexes, Linnæus founded his arrangement of plants. Further outlines of this will be found in other parts of this treatise, and scientific terms will be defined by the glossary at the end of the volume. We have, however, studiously avoided technical language where it has been possible, wishing to render vegetable physiology as entertaining as it is useful.

The substances of plants are in general said to consist of wood, gum, fecula or starch, sugar, gluten, albumen, fibrine, gelatin, caoutchouc, or india rubber, wax, fixed and volatile oils, camphor resin, gum-resin, balsam, extract, tannin, indigo, acid, aroma, the bitter, the acid and narcotic principles, ligneous-fibre, etc. Many of these, however, are convertible into one another by heat, air, moisture, or alkalies, which change more or less the relative proportions of their constituents. Modern chemistry has added others, or arranged the same under new names and forms of combination and much diminished and changed the terms by which vegetable substances have been known. A chemical analysis has proved the substances to be carbon, oxygen, hydrogen, nitrogen, sulphur, silex, oxide of iron, magnesia, carbonate of lime, potash, etc., and the various parts of plants are composed of these in different proportions. The formation of substances composing plants is the result of chemical operations during their growth and the development of fruit. The process of combining the original elements, their absorption by heat and light, their unition in various forms and combinations, and also the resolving of original substances into other forms and compounds, constitute more especially the important and interesting science of *organic chemistry*. (See another article.)

Principles of Plants.

The proximate principles of plants are the products of chemical combinations effected by the action of the vital principle. Such are the vegetable acids, wax, resins, the fixed and volatile oils, etc. The *ultimate principles* are the elements composing the proximate principles, as carbon, oxygen, and hydrogen, and these are proportionate to the nature and quantity of these elements. Thus those substances composed of them form one class of proximate principles and those, with the addition of nitrogen, another class. Those of the one class have an *excess* of oxygen, (the general acidifying principle) and therefore constitute the

Vegetable acids. Acetic acid, or pure vinegar, is commonly produced by the fermentation of wine, cider, etc,: it is also found pure in the elm. *Malic acid* may be obtained from green apples, and barberries. *Oxalic acid* is found in a species of the *sorrel,* or the genera *oxalis* and *rumex. Tartaric acid* is obtained from the tamarind, cranberry, etc.; and when combined with potash, forms *cream of tartar. Citric acid* is found in the lemon and is mixed with the malic acid as in the gooseberry, cherry and strawberry. *Quinic acid* is obtained from the Peruvian bark. *Gallic acid* is from the oak and sumac, and is very astringent. *Benzoic acid* is found in the *laurus benzoin* and *vanilla;* it is highly aromatic and is the agreeable odor of balms. *Prussic acid,* an active poison, is obtained from peach meats and blossoms, bitter almonds, cherry leaves and meats.

Gums, sugar, etc., compose that order of proximate principles in which hydrogen and oxygen are in the proportion to form water. These unite with water, but have little taste or smell. They compose *gum arabic;* the common gums of the peach, cherry and other trees. *Sugar* is from the sugar cane, maple trees, beets, corn stalks, pumpkins, sweet apples and most vegetables with a sweet taste.

Oils, wax, resins, etc., (in which hydrogen is in excess) are of the second order of proximate principles. They do not unite with water, *Oils* are *fixed,* as oil of almonds, olives, flax seed (linseed oil) and *volatile,* which have aromatic odors that fly off when exposed to the air, as the oils of orange, lavender, rose, jasmine, and peppermint, and when mixed with alcohol they form *essences.* The *aroma* is the volatile or ordoriferous part exhaled from aromatic plants, especially abundant in warm climates. *Wax* is found on the fruit of the bayberry; and bees wax is produced by bees from the polen of flowers. *Resins* exude from the pine, etc.; they are insoluble in water and inflammable. Mixed with volatile oils they form *balsams* which are thick and inflammable, as balsam of tolu, copavia, etc. When mixed with gums they are then *gum-resins,* as gamboge, guaiacum, aloes, assafœtida, etc. *Gum elastic,* or caoutchouc, from South American and

some other trees of the tropics, possess remarkable properties. The juice of the common milk weed is said to be similar to that of the India rubber plant. The valuable properties of these substances will be treated in the second part of this work, with those of the following.

The second class of proximate principles are composed of the ultimate elements we have mentioned *with nitrogen.* Such are *opium*, the narcotic principle of the poppy; *hematine*, the coloring principle of Campeachy wood; *indigo*, from species of the indigo plant, *gluten*, from the cotyledons of leguminous plants, as beans and peas; also from the albumen of wheat, rye, etc., when separated from the starch. *Jelly* is the juice of suculent fruits, as apples, quinces, currants, etc. The coloring principle of plants gives to them their green color, by the aid of light. It is changed, as in autumn, by the formation of an acid. Thus a drop of an acid on the green part will turn it to a brown. The coloring matter of some plants has never been obtained separate from the plant, as in logwood, and saffron. The red coloring of fruit is produced by the combination of an acid with a blue coloring principle, as an acid will do with all vegetable blues; this is deeper in proportion to the quantity of acid. An acid with iron is the common coloring principle of flowers.

The composition of the sap of plants is from the before-mentioned elements and water holding in solution the earths and their metalic bases, alkaline, salts, etc., with vegetable and animal substances. It is not obtained pure, being always mixed with the proximate principles before-mentioned; and it differs in plants in proportion to those principles. The power or property of a plant to secrete one kind of substance and not another depends on their constitutional peculiarities, as with races of men in the formation of their different colors. Water is always a predominant constituent of the sap of plants. An analysis of the sap of the elm gives water, volatile matter, acetate of potash, carbonate of lime, sulphate of potash and vegetable matter; of the *beech*, water, acetate of lime, acetate of potash, gallic acid, tannin, mucous extract, acetate of alumine, etc. These show the differences in the elements of the sap; they also differ materially in their proportions. The odor, taste, nutritive and medicinal qualities, color, etc., are all the result of these elements, variously combined. The elements are the same in substances of very different character, solids as well as fluids, but their mode of combination may form vinegar or a liquid in one, and sugar or a solid in another. By knowing these elements and their proportions, similar substances may be produced by the chemist, but not the form and organization of the plant, these being alone the work of nature in conformity with laws established by Supreme Wisdom.

The nourishment of plants. Being deprived of the powers of locomotion, plants must have organs to obtain their food from the situation in which they are placed, and also for assimilating it. This food is in a liquid or aeriform state. The solid particles held in liquids must be in a very fine state, as commonly diffused in water or rain. When placed in water, plants bloom, but the nourishment of the water is soon exhausted. Distilled water has lost that nourishment, or its carbonic acid gas, etc., and plants soon die in it.

Sponglets or suckers, like the organs of insects that live by suction, are minute sponge-like vessels, on the point of the rootlets, radicles, or small fibres. These pores admit only of fine particles dissolved in water, otherwise they become obstructed and the plant perishes. The pores or suckers of leaves are similar, and perform similar functions.

The sap vessels are congeries of fine tubes, straight and curved, forming lace-work, or they are of a beautiful spiral form. *The straight vessels* are hollow threadlets, fifty times finer than a hair, and forming, together, large tubes. *The spiral vessels* act singly or in bundles in every part of the plant, except the bark. *The circulation* through these, upwards and downwards, is elsewhere alluded to. The *organs of aeration* are not like those of the lungs, any more than the pith in the cirulation is like the heart of animals; yet analogous functions are performed by them in both. They breathe, and it is by the air they are chiefly nourished, as will be seen in another place.

Organs of sensation in plants. It has been thought by some that plants are endowed with sensation, sentiments and propensities. Nervous organs have been disclosed, it is said, in the sensitive and other plants. There is at the base of the leaf-stalk of this plant, a swelling collar constituted of a delicate tissue of cells, on which the motion of the leaves depend. The under part being cut away, the leaf bends down and cannot again rise, and the upper part being cut, it cannot bend. These are acted on, it is believed, by nervous globules, or grains or *ganglia*, as diffused in all plants by medulary vessels. The effects of experiments certainly show an analogy between plants and animals. Leaves and flowers turn to the light when twisted; these curl up and die when watered with poisons. Twining plants twine from right to left or left to right, according to species.

The existence of plants has been compared to that of animals when asleep, their functions proceeding during the time without consciousness. A seed placed in the earth is similar in its nature to the egg of an animal, and the effects of the earth would seem not unlike that of sitting upon it, or the development of the young of amphibious animals with the egg covered by the earth. It is obviously very difficult to determine at what point vegetable life ends and animal life begins. The sponge is in many respects less sensible than some plants, yet

it is ranked among animals; and so also with corals. And, although we show hereafter how plants grow, yet it may not appear plain how they live. They live, it is true, like animals, by the food they receive and assimilate, yet the generation of the vital principle which constitutes life is not explained. By observing, however, the facts which are hereafter stated, it will be seen how they live best, how they decay, and how they die.

Age of Plants.—Many small funguses, called *moulds*, live but a few hours, or not longer at most than a few days. Garden plants and mosses live but one season, dying of old age as soon as they ripen their seeds. Others live two years, and sometimes three, if their flowering is prevented, such as the fox-glove and hollyhock. These are the annual and biennial shrubs, herbs, etc. Many live not only through the winter, but are perpetually, or perennially green. Such are evergreens or forest trees. These live oftentimes for many centuries, producing annually new leaves. Thus the olive, vine, oak, cedar and chesnut, live three hundred, and even a thousand years. The dragon's-blood of Teneriffe is estimated to be two thousand, or more, years old; and the banian may be six thousand. The interior of trees often becomes too compact for the sap to circulate, or for the formation of new vessels, its moisture passes into younger wood, and the fibres shrink and become powder: but the outer parts live, and the tree survives, even for centuries.

Comparative Physiology of Plants.

An observance of the relations between animals and plants is highly instructive and entertaining. Many of the most important functions in the life and growth of plants, are seen to be not only analogous, but apparently the same as in animals. This cannot fail to arrest the attention of the common observer, as well as of the naturalist. It is frequently alluded to by some writers, who, at the same time, affect to scout the idea of there being any thing more in all this than a "*seeming* resemblance." The coincidences are so striking, that constant reference is made to them without a show of reason for dissenting from the conclusion of their functional identity. But the reference is followed by the assumption that the distinctions are, nevertheless, so obvious, that any other conclusions than those *they* draw would be inadmissible. This assumed guardianship of men's opinions, without facts as a basis for their declarations, cannot have escaped the attention of the general reader. The ostensible reason for this is founded in the narrow conclusion, that to infer a common dispensation of the gifts of Supreme Power and Wisdom in the endowments of or-

ganized beings, would interfere with previously formed opinions of the ultimate designs of that Being. On this subject there is quite too much cant, and too little ingenuousness in the world. As if, with all the facts which God has spread before us in nature, it would not comport with His wisdom to be equally liberal in his blessings. Hence, lines of distinctions are assumed in the premises, which apply alike to Creative Power, and the conclusions of men, that "thus far shalt thou go, and no farther." The feelings which can thus bound the goodness and benevolence of an all-wise Being, by human prejudices and assumptions, and for the narrowest of reasons, cannot be envied by an enlightened observer of the works of Nature.

The Instincts of Plants. If, with this view of the subject we may be allowed the expression, are remarkable, and evidently correspond with the same powers in animals. In some plants they are obviously far more remarkable than in some animals. When, therefore, we are unable to define distinctions, or show reasons why they should exist, it would be much more rational to refer similar effects to similar causes, as in all other modes of reasoning. Where, also, ignorance does not allow men to speak from known facts and clearly established principles, it is safer to doubt than to assume to base conclusions on what is not known. It has been common, however, to follow prejudices in other departments of organic life as well as in this; for it is inferred, that "if ignorance be bliss, 'tis folly to be wise." Thus, the received opinion is, in spite of the demonstrations of science and of daily observation, that the whole of the lower orders of animals are without the least evidence of reason; and, in conformity with this opinion, it has been the universal custom, though none the more rational for its being so, to resolve all the manifestations of mind in the whole world of organic beings, man excepted, into the general powers of "*instinct*" while the same powers in man are referred to as not less remarkable evidences of his reasoning faculties. This, to say the least, is a very convenient mode of avoiding inquiry, and of settling a point about which little may be known; but it does not satisfy the ardent and candid student of nature. The elephant, which, on finding it out of his power to reach with his trunk, a potato near the wall opposite from that to which he was confined, carefully extended his probosis in an exact line with the object of his wishes, and with his breath forcibly blowed it against the wall, so that it rebounded to a position within his reach, manifested the same mode of reasoning from effects to causes, that Newton did on seeing an apple fall from the tree. But this is no more remarkable than daily exhibitions of reason in lower animals. The African monkey manifests powers of mind which very many other beings more elevated in name, and belonging to the same regions, rarely evince. All this, however, may be called "instinct," "ingenuity," or any other convenient term, in the elephant, the beaver, monkey, or the

dog, for the gratification of prejudice, or for the avoidance of the term "reason," but no reasonable person will assume to say if he reasons from cause to effect himself, that the same effects produced by the lower animals as those produced by man does not presuppose the same causes and the exercise of the same faculties. That man possesses the reasoning faculties in greater perfection or power than lower animals, and also distinct moral sentiments, no one will deny; but this is no evidence that lower animals do not possess reasoning faculties; for the grades of perfection and powers of exercise vary as much in man as they do in other animals. To deny, then, to all the lower animals, as it is popular and somewhat fashionable to do, all powers of reasoning, is to evince in man less of those powers than he claims and should be accredited for.

But it would seem from some writers on vegetable physiology that "comparisons are odious." We would not disturb the sentiments which dictate such prejudices. We believe that to

"— Vindicate the ways of God to man."

sentiments are required of a very different cast. While the distinctions beween organic and inorganic bodies are apparent and striking, many of those between the two classes of organic beings are not thus apparent. Similar phenomena, therefore, can only be referred to smilar causes. It does not necessarily follow that because organs produce similar functions, they are necessarily the same in organic structure. Many parts of animals vary much in their organization, while they perform similar functions with those differently constituted. It is the same in plants. The organs of circulation and of respiration in plants are very different from those of animals, still they are admitted to perform similar functions.

Feeling appears to be the principal distinction proposed between plants and animals. The justice of this distinction, however, does not appear to us apparent. Linnæus declared his views of these distinctions in the following summary aphorism. "Stones grow, vegetables grow and live, and animals grow, live and feel." The sentiment of this declaration is almost universally adopted, although most men confess their inability to decide where feeling begins or where it ends. But stones do not grow, for it is a distinction between the mineral and vegetable kingdom, that members of the former do not increase in size by anything within themselves. Mere depositions upon their surface is not growth. Now, that plants *feel* is as clear and evident a proposition as that animals feel. But the inference is that if feeling be allowed to plants we must allow them to possess organs of sensation similar with those, perhaps, of animals, which would indicate *intelligence*, a fact that few are disposed to admit,

although the same facts resulting from precisely the same cause in animals, no one doubts to be intelligence and that, too, oftentimes of a high order. Here, as with instinct in animals, all phenomena of this kind, not understood, are referred by the wholesale to "physical causes." It must be admitted, however, by all advocates of physical causes, under such or any other circumstances, that no evidence either of sensation or of intelligence is, or can be manifested in man or lower animals without physical causes. The distinction therefore fails. Nerves, or a brain, are essential both to sensation and intelligence and these are physical agents; hence the existence and operation of physical causes are as essential to the production of an effect in animals as they are in producing an effect in vegetables. No individual of either the animal or vegetable kingdom wills or acts without the agency of a physical cause. The sensitive plant that trembles and shrinks at the approach of danger, or the *Dionæ* that seizes its enemy with its leaves and wills, if you please, to close its parts for protection, does so through the agency of physical causes, and so does an animal act for like reason. If no physical effect were produced on the nerves of animals, either through sight, sound, or external sensation at the approach of a body, no will, act, or motion would be produced, as the result of fear, or for any other reason. Call these phenomena by whatever name we please, it is the same in both animals and vegetables. The feeble and apparently conscious tendril, that seeks to elevate itself and adopts various and curious expedients to obtain its objects, acts from some cause within itself, or it would not act at all. If this is not from a consciousness of its wants, what is the cause of its action? Is it that objects at a great distance, (to which it often goes, avoiding intermediate and apparently better support,) possesses some unknown physical power of attraction? If so, that power has the same effect on its organs that it would have on those of animals, and no more. But this is not offered as a reason for the apparent preference which the tendril manifests. How then can it know that one object is better than another for the accomplishment of its purposes—for purpose it has, or it would not seek, on account of its conscious feeble nature, any object to sustain its growth, much less take so much apparent pains to seek that which is best.

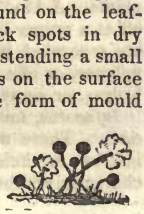
But we have thrown out these remarks rather to awaken attention to the physiology of plants and to induce their careful study, rather than to advance any new views or to controvert those of others. There is, however, a descrepancy in the opinions of some who, whilst they assert the stale opinions of others, venture to determine what they profess not to understand in vegetable life. This subject is to be approached, like all others, for the purpose of arriving at truth and not for the establishment of previous opinions or favorite theories.

Microscopic Vegetables.

Some of the class of fungi and mosses we have noticed elsewhere; but such as are invisible without the aid of the microscope, present the most remarkable peculiarities in vegetation. Without this magnifying power, we never should have understood the singular character and economy of these plants. When collected in masses they are called canker, mould, etc., and are found on decayed vegetable and animal substances, or covering damp walls of cellars and caves. They are all parasitic plants and are often found on grains, grasses, etc., occasioning the diseases to which they are subject. The number of species already discovered is immense, and their various modes of propagation render them one of the most interesting subjects in vegetable nature.

The most common species is the *common Ascobolus.* It is found during the whole year, of a greenish color and of different forms, according to its age. At first it is of a globular form, of the size of a pin's head; it gradually opens and forms a cap and then becomes flat. The seed vessels are small black specks which slowly rise from the surface of the fungus until the seeds are ripe, when they suddenly burst and distribute the seeds over the ground. Another of a star-like form is commonly found on rotton wood. The seed vessel is in the form of a minute ball within the body of the plant. When the seed is mature the vessel splits into five or six equal parts; the inside lining then suddenly, with a jerk, turns inside-out, throwing the seed to a considerable distance. The lining then forms a dome over the top. The whole process is otherwise highly curious. Another kind is found at all seasons on the dead leaves of the holly. It is like so many black spots of the size of a pin's head. Its structure is very curious; it has three or five seed vessels. The seeds, when ripe, are discharged in a stream from one or both ends of these vessels. Another minute fungus has been found as a parasite on a parasite; i. e., attached to and deriving its nourishment from another fungus, growing on rotton wood. The seeds are dispersed from the head of the plant. Another very minute fungus, also a parasite on one of its own order, is found in damp places in spring. The seeds and the physiology of the plant are likewise very curious. Another is found on the leaf-stalk of the sycamore. It appears like minute black spots in dry weather; but in moist weather it appears gradually distending a small slit in the surface. Another singular fungus appears on the surface of old leather. That appearing on an old shoe in the form of mould we here give a magnified view of.

These curious vegetables will be seen to possess much interest as regards their forms and habits. A single plant is invisible to the naked eye; and it is



only where they are collected in masses that they are observed; but with a powerful glass the forms we have mentioned appear distinctly.

The various species of microscopic mosses have, of course, variously formed organs. The seed receptacle under the glass presents very singular appearances; and, on examination of their structure in this and other particulars, they cannot fail to strike us with surprise. Many species which inhabit the water keep it pure and wholesome and their remains ultimately contribute to the formation of useful soil. Peat-moss, so valuable in many countries as fuel, are formed in a great measure of these mosses. They sometimes protect plants from too great heat in summer and from severe frosts in winter. They are likewise useful as food for animals. The arctic bear is said to line his cave with them against the approach of winter. The squirrel's warm pendulous nest is formed of them, and also that of many birds. Numerous tribes of insects find a safe retreat within them and subsist on their delicate leaves. The Laplanders prize a bed of moss as much as we do one of feathers; they also employ it as bed clothes for infants in the cradle. The mosses are made into brooms in some places in England and the north of Europe and some have been used as dyes and medicines.

Animal Plants.

These are generally marine productions: many are fixed to rocks, and are generally called zoophites and radiated animals. The sea-nettle, daisy, marygold, carnation, etc., are carried about by the water without any apparent volition. The great variety of corals, the sponge and other animals are little, if any in advance of plants. They are not so sensitive, and consequently manifest less of life. Sensation in them cannot therefore be any more evidence of their being animals than the same power in plants. Some species of the sponge attach themselves to crabs in the same manner as some parasitic plants do to trees. They are nourished by the water which they imbibe through their smallest pores and which they part with through their largest ones. The fibrous part is therefore the skeleton of the animal. They produce their species in a similar manner to plants. A kind of germ is formed like a bud upon a stalk. This falls off at a proper time and becomes an animal, like its parent. If these are separated into parts, each part will become an animal, like the polypus, or like plants by cuttings or shoots. Some of these are called hydras, or many headed, from this circumstance.

Infusoria, small homogeneous masses, are an extensive class of animals. These with many of the fungi before mentioned, are greatly inferior in their organization to plants. The single sense of touch characterizes the zoophites as animals. The senses are increased in

number and acuteness as animals advance in the scale of organized beings, some having two, some three and some four, etc. The power of locomotion, it will be seen, cannot be urged as a distinction in favor of animal life; for, being attached to rocks or floating without voluntary motion, they are no more locomotive than plants. Nor can the presence of nitrogen, which by some has been considered a proof of animality, be deemed conclusive, since it is found also in plants. The fact is that individuals of both kingdoms approach one another so nearly in some particulars that no line of distinction can be drawn. The idea that because the elementary principles of plants and animals differ in the fact that plants possess more carbon than animals and animals more nitrogen, there is a notable distinction between them, appears too much like an effort to discover differences without a reason. The only differences, then, that appear marked, are in the facts that plants feed on inorganic matter and animals on organic matter, and that they throw off oxygen and inhale carbonic acid, while animals throw off carbonic acid and inhale oxygen. The fact that life is more limited in plants than animals and that they consequently manifest less of the powers or properties of irritability, will readily be seen and acknowledged.

Laws and Vital Principles.

Inorganic matter is the medium through which organic matter derives its oganization and vitality. This matter in its ordinary state, neither undergoing the processes of organization or of decomposition, belongs especially to the mineral kingdom. From this, then, the vegetable kingdom mainly derives its powers; and from the vegetable kingdom is derived those of the animal kingdom. It is only when animal and vegetable substances have been deprived of vitality, and are no longer subject to the laws of organic matter, but have become, by death, subject to the laws of inorganic matter, that vegetables are in part supported by them. But animals are supported by organic matter, or that which has had vitality, and before the laws of inorganic matter have operated upon it. It will be perceived that inorganic matter, or that of the mineral kingdom, possesses the same properties when divided or ground to powder that it does in the mass; i. e. each particle possesses those properties in proportion to its size; while the organic parts of animals or of vegetables, if thus crushed or divided, are deprived by death of the vital forces which distinguished them from inorganic matter.

The seed of a plant, if placed in the earth, forms a living plant, which, from its incipiency, opposes inorganic laws, or those of decomposition. The vital principle which it has received from the seed and which the seed having parted with, together with a portion of its sub-

stance for its support, continues to animate the plant; while the remainder of the seed has thereby become subject to the inorganic laws and rots, or is decomposed in the ground. The plant lives and flourishes, and by the force of its vital powers, thus obtained, appropriates inorganic matter to its support and the development of its organs, until by violence or the exhaustion of its vital energies at maturity, it is at length, and in turn, subjected to the force of the inorganic laws—it dies and is decomposed, either in the ground or by being consumed by animals. The seed originally derived its vital principle from its parent plant through its pericarp, or fruit, and retained it within its envelops until buried and excited to germination by the heat and moisture within the earth, when it gave it to its offspring.

During the period from the birth to the death of a plant, periods of repose intervene, as with biennial and perenial plants in winter. It loses its leaves, the principal means of its support, and remains partially dormant, until awakened to action by the heat of returning spring, when its leaves are renewed and its dormant energies call forth new shoots, buds and blossoms, and the scene of life, health, vigor and action is reenacted.

Light is evidently one of the "necessaries of life" and plays an important part in vegetation and the economy of plants. By it they form their combustible parts. The carbon they receive must be, in some way, modified by its influence before it can become a constituent of the plant. During the night they probably do little more than to digest the food they have received during the day and to separate and give off that which is not found nutritious. Light is a primary agent from the time the plant emerges from the soil to its death. Its nature becomes changed by its absence so that the observer would scarcely recognize its identity by its form, color, taste or odor. If a branch of any spreading plant penetrates in its growth a subterranean place its character becomes not only thus changed, but is found composed almost entirely of water and assumes the nature of a fungus, so that all of its native beauties and virtues are lost; it is a mere pulp deprived of its resinous qualities. The acid taste of some vegetables as the endive and celery, may, however, be corrected by bleaching.

Diseases of Plants.

These arise from many causes, as with man and lower animals. They may be detected and cured by a careful observance of the nature and wants of plants. The change in the color of the leaves of the box and holly is said to be a disease or disordered condition of the juices. Too great or too little food, or that which is poisonous, produces diseases. Too little or too great light, heat, air, water and soil;

an excess of light, so as to cause the escape of too much oxygen, or too rapid a deposite of carbon, are also causes of disease. By a knowledge of the properties and characteristics of plants we may perceive their wants and frequently apply remedies adapted to their diseased condition. Their health is often affected by external injuries. Rains and winds also injure them, oftentimes. Smoke obstructs the pores of the leaves and is thereby greatly prejudicial.

Animals are a frequent cause of disease in plants. Some penetrate the bark and deposite their eggs, producing larvæ and the insect *cynips*. By one kind of these, protuberances are produced, as the nut-gall of oaks, apple or berry galls. Some prey on the juices, as with the insect *cochineal*, a species of which is so valuable for dying a scarlet color. The Mexican plant *cactus cochinilifer* is that which they feed upon. Disease is likewise produced by contiguity with other plants, either by ejecting deleterious matter from their roots or withdrawing that which is necessary for one or the other. Mosses and lichens attach themselves to trees and absorb moisture or attract insects, both of which destroy the wood: they do not however feed on the juices, and are therefore called false parasites. The miseltoe pierces the bark and feeds on the juices and is a true parasite. Another parasite called the *pterospora* is found on the leaves and branches of trees. *Smut* and *rot* are fungi, the former fastening itself on the ears of cereal grains and the latter preying on the seeds. If these seeds be planted the disease will be continued in the plant. *Rust* and *ergot* are also fungi, the one a disease of rye and the other of grasses. As plants renew their parts annually, they seem less liable to be affected by old age; still their powers of renewal, or vital principle, becomes exhausted in time as with animals. In annual plants, the production and maturing of fruit exhausts their energies, during the year, and in biennials, in two years. These, however, as with perennials, depend much on their constitution and the amount of their fruit, as with the apple tree which, being very fruitful, does not often attain to so great an age as the oak, the fruit of which is light.

The effects produced by insects on plants is vastly greater than in producing deformities. Like great fires, however, they may often prove a benefit and maintain a balance among the various species of plants, for the devastating effects of these insignificant agents are wonderful. Scarcely a plant is without one or more species of insect. The diseases they produce often constitute an important article of food, medicine and commerce, as we have said, in the *cactus*, or cochineal insect, the *lac* insect, the *cantharia* or Spanish fly, the gall apples, and the nut galls.

The sweeping destruction produced by the locust affords a striking discrepancy between the magnitude of the means and that of the effects. They can strip entirely of their foliage thousands of square miles of

forest tress during one brief visit, and annihilate every appearance of vegetation; as when they thus scourged Masinissa, causing the death by famine of more than 800,000 persons! Compared with such effects, earthquakes and volcanoes dwindle into insignificance.

Their numbers are so vast as often to overshadow immense tracts of country. The swarm which passed over Smyrna, like a living cloud, for three days and nights, was calculated to be 900 feet deep, more than 40 miles wide and 50 miles in length! The number exceeded 168,608,563,200,000, and the magnitude of the mass, if gathered into a heap, would exceed by more than 1,030 times that of the largest pyramid of Egypt, or would encircle the whole earth with a belt a mile and a furlong wide. When borne down by tempests their bodies have overspread large tracts of country four feet deep, or formed, when thus driven into the sea, winrows along the shore 3 or 4 feet deep, for 50 miles in extent!

The *aphides*, or rose bugs, the flies of the turnip fields, and the timber grubs are also terribly destructive. The "great goat moth" is likewise a powerful and destructive insect to plants. Its larvæ are proved to increase their weight 140 times within an hour, and when full grown, are 72,000 times heavier than when hatched! The *termes bellicasus* lays sixty eggs per minute and continues to do so without interruption for an incredible time; thus laying, it is calculated, 3,600 eggs per hour, or 86,400 per day! The common flesh fly, it is said, will give birth to 20,000 young; and the three flies, *musca vomitoria*, Linnæus and others have said, can devour a dead horse as quick as a lion, or commit more ravages than an elephant. They are thus important scavengers. The pine forests of Germany have sustained immense injuries from a small beetle which has deposited 80,000 larvæ in one tree. Preying on the inner bark, they have thus destroyed in one forest 1,500,000 trees and then, on maturity, taken wing and flown to other forests with like results. It was a subject of great wonder at one time in London, how the elm trees in some of the parks became completely stripped of their bark. Suspecting it to be caused by soldiers, many were arrested and watches stationed to secure the depredators; still the work of destruction ceased not. Various other causes were supposed and severe measures taken to punish the culprits; until, at length, they were found to be no others than insects, which were ultimately checked in their career by art.

The *economy of plants*, as observed in their habits, is strikingly illustrative of the harmony of nature. We see them adapted to the peculiarities of their situations. If indigenous to the tropical climate, they cannot live in our temperate zone without the aid of art; if inhabitants of the valley, they cannot dwell on the mountain's summit; nor, if the rugged tenants of the bleak and frosty mountain, can

they endure the enervating daliance of the luxurious vale; nor can either dwell with the aquatic plant immersed in a liquid element. We have noticed many of the habits of plants; and, in the progress of our remarks, we shall notice how they minister to our wants as food, clothing, medicines, in the arts, and for the support of inferior animals. The interest with which they must be viewed, with their numberless shoots urging into life and action their millions of buds, that are expanded into light and being by the genial sun, rivalling one another in their efforts to produce the fairest flower and choicest fruit —these, we say, render them objects of peculiar attention. But a change comes over them, as we have seen, and as we daily witness, with fellow mortals. They die and mingle with the soil, and from their decomposed remains spring up new beings.

The various forms of plants, in this connection, cannot fail to strike us with wonder. Although this is remarkable in the 100,000 different species of insects, yet the variations are not so obvious in the range of such minute objects as in plants, nor is it more prolific in wonders. In every situation capable of sustaining life we find plants arise and continue their species in endless perpetuity. The germs are every where found where the soil is upturned, and where they may have remained dormant, perhaps for centuries. Islands formed of coral-reefs, and even sterile rocks, cinders and lava of recent volcanoes, are found covered with vegetable forms. The germs that float invisibly in the air, successively follow each other and plant the most barren places with verdure, which, rising from grasses to shrubs, and from shrubs to trees, soon present all the varied forms of meadows, thickets and forrests. Thus, considered in reference to their utility, the beauty of their forms and colors, their fruit and fragrance, or the continuation of their species, they forcibly impress us at all times with admiration and delight.

The utility of plants is unbounded and illimitable. No where do they rise in vain. The lofty tree, whatever its intrinsic properties, presents its cooling and refreshing shades for flocks and herds, and offers an asylum for the insect tribe and for the songsters of the air. As food, the bread-fruit tree of the Pacific, and the cabbage tree of our own and other southern climes, the sugar maple of the United States, the tea tree of China, the sugar cane, the cotton shrub, and the coffee tree, and the innumerable fruit trees which every where yield in rich profusion their varied products; the fountain tree of the Canaries that yields pure water; the tallow tree of China; the Mulberry tree, nourishing myriads of beings that industriously supply us with siks; the salt tree of Chili that daily supplies the people with salt; the cinnamon, pimento and clove that furnish our spices; the Peruvian bark, the senna, manna and innumerable other medicinal plants; those too yielding their healing balsams, turpentine, resins, oils and gums—all,

all furnish us with their invaluable products. Nor are they less important in protecting us by the buildings we raise with them, or in the conveniencies and luxuries they afford us by the ships we build of them to transport the products of one clime and people to those of another.

Shrubs and herbs also supply us with every variety of food and useful product. There the golden wheat presents its abundant crops, and here the flowing oats and potatoes, the loaded pea, the swelling turnip, beet and carrot, the luxuriant grass and bountiful corn, crown the earth's surface with life and nourishment; while the universal smiles of variously tinted flowers invite us abroad to view the charms and inhale the odors of their fragrant breath.—All here spread out before us the rich bounties and varied delights of vegetable nature. Well may it be said, with all these in view, that "In reason's ear they become preachers."

Differences in the Species of Plants.

These are known as *races, varieties* and *variations*. Where these differences are remarkable, or striking, and are ever continued by the parent to the offspring, through the seed, they are termed *races*. The polen of one species being strewed on the pistils of another, the seed produces a plant resembling both species, but the *race* is continued. *Varieties* are produced by grafting, or by other means than by the seed, and thus they are continued. *Variations* are slight differences produced by variations in soil, climate, moisture, &c.

Anomalies, or deformities, are produced by accidental circumstances; such as the adhesion of parts ordinarily separate, as with the leaves, flowers and fruits. Some assert that the single petal of many flowers are, in fact, many petals, and that they adhere together before the expansion of the flower, as in the blue bell and stromonium; and thus with the sepals of monosepalous plants. Peculiarities are likewise produced by the want of the necessary vigor to mature their parts, as is observed in the different number of seeds in the flowers of the same plant. Of the six acorns of the oak, only one is matured; and of the six in the horse chestnut but two are perfected. Some organs appear incapable of performing their natural function, and thus produce deformities. Buds, unable to develope leaves, form a permanent deformity upon the stem, as with the prickly pear, where the branches become thick from imperfectly formed leaves. Excessive nourishment induce the stamens and pistils to swell and become petals, as with all double flowers. Thus poppies naturally have many stamens, but double poppies are often seen without any stamens. This is also common with the rose which has, naturally, five petals, with many stamens and pistils; but, in full double roses, these are

not found. Foot-stalks are often changed also to leaves and petioles; and peduncles sometimes change to tendrils, as with the vine. Buds are often transformed into thorns, caused by a superabundance of buds, in which the sap becomes hardened, exhibiting short protuberances. Many changes are affected by cultivation, when natural deformities disappear. Changes produced by geographical situations and the influence of external agents on the growth and position of plants are considered in another place.

Signs of plants, produced by the atmosphere, are often observed, and are by some considered signs by which to judge of the weather.

It is said that not only the coming weather may be foretold by an acquaintance with flowers, but also the time of the day and the time of the year. Linnæus is said to have possessed such a knowledge of them as to need no watch, calender nor weather glass. Lord Bacon observed that when the flower of the chickweed expanded fully and boldly no rain will succeed for some hours or days. It partially conceals its small flower in a rainy day, and entirely shuts it up with its green folds when there is a prospect of a long storm. If the flowers of the Siberian sow-thistle keep open during the night, rain, it is said, is certain to fall the next day. The leaves of the trefoil are always contracted at the approach of a storm, and hence called "the husbandman's chronometer." If the *African marygold* does not open its flowers by 7 o'clock, A. M. rain may be expected with certainty on that day. An uncommon quantity of seeds is produced by *white thorns* and *dog-rose bushes* in wet summers, and this is considered a sign of a severe winter. Many plants with compound flowers direct them towards the east in the morning, carefully following the direction of the sun, and appearing towards the west in the evening; but, before rain, they are as carefully closed, as with the tulip. A species of the wood-sorrel doubles its leaves before storms, but unfolds them under a serene sky. Cassia and the sensitive plant do the same. The flowers of the *pimpernel* appearing widely open in the morning indicate a fine day, and if the petals are closed, rain may soon be expected; it is found in stubble fields. Nettles appearing abundantly in winter indicate a mild season. Most plants, indeed, expand their flowers fully on fine days, but all do not close their petals on the approach of a storm.

Periodical Opening of Flowers.

The yellow and purple Star of Jerusalem, or the goats beard of both species, open their flowers in the morning and close them at noon, without regard to the weather. The evening primrose opens with a snapping noise at sunset and closes at day break. The flower of the garden lettuce opens at 7 and shuts at 10 o'clock, A. M.

A species of the aloes, without prickles, gradually opens its large and beautiful flowers at 5 o'clock, P. M. in July, exhales its odor, then droops and dies; and, by 10 o'clock it is entirely withered.

The marygold, the tamarind tree, water lilly, false sensitive plant, with others of the class diadelphia, always expose their flowers during a serene day and close them at night. The tamarind tree is said to enclose with its leaves the flowers and fruit each night, to protect them from rain and cold. The beautiful flower of the *cerea*, a foot in diamater in Mexico and Jamaica, expands and emits a fragrant odor during a few hours of the night and then closes *for ever*. The flowers of the dandelion close entirely during the extreme heat of the day: it opens a little past 5, and gathers its petals about 9, A. M. Forty-six flowers have been mentioned as possessing this sensibility. Those which observe less accuracy in folding, though in accordance with the weather, are called *meteoric flowers;* and those opening in the morning and closing daily before evening, in accordance with the duration of the day, are *tropical flowers;* and those opening at an exact hour, and closing mostly at a different hour are *equinoctial flowers*. Very many plants droop before rain, when the wind which brings up the rain begins to blow. Most of the syngenesious plants have particular hours for closing and shutting their flowers. as the cat's-ear, which closes at 3, and the mouse-ear at 2½ o'clock. The Prince's Leaf, or *four o'clock* of the Malay Islands, opens at 4 o'clock, P. M., and closes at 4 o'clock, A. M. It is said to be used by the people as a clock.

Superstitious notions have originated in the Romish Church from the periods at which flowers blossom, if these periods happen about the time of any saint's day. Thus the dead nettle is consecrated to St. Vincent, the winter hellebore to St. Paul, the crocus to St. Valentine, a species of the daisy to St. Margaret, the cardamine, or "our lady's flower," to the Virgin Mary; and likewise the marygold, from its imaginary resemblance to rays of glory, &c. The blue bell has been dedicated to St. George, and thought to be emblematical of British rule over the ocean. St. John's wort is so called from its blooming near the day of that Saint. The plant *lychnis*, called the great candlestick, is believed to have been lighted up for St. John the Baptist. The white lilly is supposed emblematical of the Virgin Mary, and roses are supposed to fade about St. Mary Magdalen's day. The passion flower is supposed to blossom about Holy Rood day. The mandrake has been viewed by some with equally superstitious notions. On pulling it up by the roots, piercing shrieks are said to have been heard from it, and the act has been looked upon with horror by the ignorant; so that the person withdrawing it from the ground always approached it with his face turned in the oposite direction. It was also supposed to be possessed of talismanic powers, always securing good fortune to its owner. The victories of the Maid of Orleans have thus been at-

tributed to the possession by her of the mandrake root. These and other superstitious ideas in connecting natural objects with religious faith by monks, nuns and others, exhibit far less love of the good and beautiful in nature, from their intrinsic excellence, than of ignorance, and prejudice from their imaginary advantages.

Carbon, as a constituent of Vegetables.

Of the fifty-four elementary substances composing the material world, four only enter generally into the composition of bodies, viz.: oxygen, hydrogen, carbon and nitrogen; and of these but *one* is found universal. This is *carbon.* Consequently every variety of form and appearance must be given to this important element. It constitutes *one-half* of the whole vegetable kingdom and a still larger portion of the mineral world. It also enters largely into the composition of animals and forms a portion of the atmosphere and of water. Its purest form is that of the diamond, and next that of charcoal. It is the least destructible of any known substance. If heated for centuries no change could be perceived. Sugar, in which it is an important constituent, may be reduced to carbon and water, but we are incapable of reuniting these to form sugar. The process is gradual and known only to nature.

The diamond, if decomposed by means of the galvanic battery, would combine with the oxygen of the air and form carbonic acid gas, which, floating in the atmosphere till inhaled by a plant, would pass through all the secret processes of elaboration and assimilation by the plant. The plant: suppose it to be grass, is then eaten by an animal—the ox—it then again passes through all the processes of assimilation and becomes at length, incorporated in his body, as it was before in that of the plant. Now, if the flesh of the ox be eaten, it again goes through all the processes of assimilation in the human body, is converted into chyme, then into chyle, is then taken up by the innumerable lacteal vessels and carried at length, into the general circulation—into the heart, then into the lungs and a part through the arterial vessels; is thence secreted by the lymphatics and converted into the secretions —perhaps tears—taken up and passed off by the glands in various ways, or perhaps, becomes incorporated in the bones, etc., and remains for years and becomes at death, and in the process of time a constituent of the earth, from whence in many years, it may be again incorporated into plants.

Plants derive their food, in part, from matter once organized in the animal or vegetable kingdom, but not less from the mineral kingdom. A rock presenting a new surface is soon covered by lichens which, with the air, rains, etc., ultimately decompose its surface and form soil in which trees may rise and tower above it. The production of carbon,

however, in such vast quantities as is required for vegetables may be a matter of wonder; but on an examination of the natural resources and a glance at the views of Leibeg this wonder will cease. The grains of one season in this country, must afford by the straw many thousands of tons of carbon. Yet this is but a limited resource compared with the quantity yielded by other vegetable productions, the combustion of coal and other fuel, and by expirations from, and decomposition of animals. The amount of carbonic acid gas emitted from the lungs of a healthy person in 24 hours is 40,000 cubic inches, or 11 oz. of solid carbon. Thus about 100 tons of solid carbon are exhaled in this city every 24 hours from man alone. The facility with which it blends in the air, notwithstanding its superior gravity, prevents those deleterious effects on animal life which we might otherwise experience.

The formation of proximate principles, such as we have before mentioned, requires carbon to unite with oxygen and hydrogen in the proportion in which they form water. Thus 100 parts of sugar is composed of 40 carbon and 60 water; starch 41 carbon and 59 water; gums 42 carbon and 58 water; acetic acid 47 carbon and 53 water, and wood 50 carbon and 50 water, with small proportions of other elements. Starch and paper may be converted into gum, wood into acetic acid, woody fibre into gelatin, starch into sugar and wood into starch. As flour is principally composed of starch, wood, in being converted into starch, is converted into the principle constituent of *bread*. It is known that a pound of starch may be converted into more than a pound of sugar, simply by boiling it, diluted with water. Letting the water and starch stand together will in time produce the same results. 12,00 parts of water with 100 of starch, allowed to stand two months, yields sugar 48 parts, gum 24, and starch 22.

Bread may be made of beech saw-dust, carefully roasted to a pale brown, kneeded with yeast and baked in the common way. It will be seen that a small difference exists in the elementary constituents of the before mentioned bodies, and that these differences may be corrected by heat and by the addition of an acid or by the abstraction of carbon and oxygen, when those substances may be converted from one to another. Most vegetable substances contain sugar in greater or less quantities. When sugar is produced a partial conversion of the woody fibre takes place during the first fermentation.

Charcoal, as we have said, is the purest state of carbon next to the diamond; and it may appear singular that these two states of this element are derived from two entirely different kingdoms. It is obtained, as may be known, by driving off, under cover of earth and through the agency of a uniform and moderate heat, all the aqueous, alkaline, volatile and resinous parts, leaving the carbon of the wood alone. Its uses in the arts as well as for fuel are of the greatest importance. In the manufacture of gunpowder, the lightest, most compact

and equable coal is used; such as that of alder, willow and dogwood, or buckthorn. The wood is charred in iron cylinders. Gunpowder is composed of 75 parts of nitre, 15 charcoal and 10 sulphur. The charcoal of the oak or beech is preferred for the assay of metals, or alloys, and that of the vine or willow for draughtsmen. The use of charcoal as fuel is often dangerous, as it renders the air, when burned openly, unfit to support life, by reason of the carbonic acid gas it evolves and which, it is thought, covers the lungs when inhaled so as to prevent the access of oxygen. Charcoal is used for making printers' ink, Indian ink, black chalk, etc. Charred turf is a preparation of the remains of vegetables imbedded in soils. To preserve wood from the attacks of insects and from decomposition, the surface is often charred. Charred fruits, wheat and pulse intended for use by the people of Herculaneum and Pompeii are now found in their houses. The discovery of innumerable strata of ferns, palms and grasses in the coal measures and other carboniferous deposits, prove that the temperate zones of the earth, and even the polar regions, were at one period of the world within a tropical climate.

The method of making charcoal is by the arrangement of billets or sticks of wood so as to ensure the dissipation of all the parts except the carbon, and the escape of as little of this as possible. The tree is generally cut the previous season and the wood subsequently prepared and piled in a regular conical form and then covered by a coating of turf with the grass inwards. Over this is spread a dressing of earth mixed with charcoal ashes. A course of billets is first laid horizontally a foot apart radiating from a central space to a circle, say 100 feet in diamater. The central space is filled with under brush and 4 large billets set up endwise converging and secured together at their tops. The inclination of these forms a guide for the conical pile of billets placed endwise around them to the extent of the circle. Above these another horizontal layer is made, and on this is placed a central stick reaching above the top of the pile, and around this is again arranged another erect pile of billets inclining to the centre like the first. The interstices are filled with smaller sticks. The dressing of turf and earth is then laid on and the inside brush fired by drawing out the central billet and introducing brands of fire from the top. Another method is by piling the whole of the wood horizontally around the upright billets and withdrawing the upper and one of the lower ones of these to fire the brush. Another is to set up the first range of billets perpendicularly in a pit, then to place three billets conically as before, and lay the other courses horizontally to the top, the cone formed by the three sticks being filled with inflammable materials. Another mode is to form a triangle horizontally in the centre with billets, notched into each other and three feet high, with an upright timber running from the top to the bottom of the pile. The wood is

then piled up endwise around these. Earth is added or water thrown on to subdue the burning, if too great, and air is admitted if it be too slow. Four days is generally required for the burning.

The Organs of Plants.

(Necessary to nutrition and growth.)

The Root—its neck, radical and stalk.
The Stem—its branches and their branchlets.
The Bud and its scales.
The Leaf and leafets.
Appendages—prickles, thorns, glands, stings, scales, tendrils, etc.

(Necessary to reproduction.)

The Flower—The *Calyx*, its *sepales*, or leaves—The *Corolla*, its *petals*, or leaves—The *Nectary*—The *Stamen*, its *filaments*, *anther* and *polen*—The *Pistil*, its *stigma*, *style*, *ovary* or germ, and *ovules*.
The Fruit—The *pericarp*, its *cells*, *valves*, etc.
The Seed—columella hilam, albumen, *cotyledons*.
Embryo, its *radical* and *plume*.



The accompanying cut exhibits all the principal parts of a plant.

a the root; *b* the bulb; *c* root-leaves; *d* stem; *e* stem-leaves; *f* branches; *g* flower-stalk; *h* flowers. The whole is the Bulbous Butter Cup.

VEGETABLE ORGANIC CHEMISTRY.

The elementary parts of vegetables, we repeat, are carbon, hydrogen, nitrogen and oxygen. These are always present in plants, and they produce by their union all the various principles of which plants consist. The principal parts are composed of carbon, with oxygen and hydrogen; these last two being in the relative proportion in which they form water. These parts are the *woody-fibre*, *starch*, *sugar* and *gums*.

Another class of vegetable substances, such as the organic *acids*, contain oxygen in a greater proportion than is necessary to form water with the hydrogen, and they thus have an excess of oxygen. A third class of vegetable compounds, such as the *volatile* and *fixed oils*, *wax*, and the *resins*, contain carbon and hydrogen, but no oxygen; or less

of it than is necessary to convert the hydrogen into water; thus these have an excess of hydrogen. Nitrogen is a part of vegetable *albumen, gluten* and of the *acids*. It forms but a small proportionable part of the weight of plants, yet it is always present in some part. The juices of all plants contain *organic acids*, generally combined with *metalic oxides*, which are found in the ashes of plants.

A plant requires, then, for its growth, such substances as contain carbon and nitrogen, or which are capable of yielding these two elements for its organization; and also water, or its two elements, oxygen and hydrogen; and finally, a soil is required which will furnish the plant with the metalic oxides, or inorganic bases.

Each genus of plants requires special conditions for their life; and individuals require many conditions: they cannot be brought to maturity, indeed, if but one of these be wanting. Their organs, like those of animals, contain substances of very different kinds; and in all are found metalic salts. For the production of all their organs, therefore, their food must contain all their elements. These may be united in one substance, or they may exist in several.

Vitality in each organ is the power it possesses at all times of reproducing itself; hence it requires substances containing those composing itself and capable of transformation. When this is not the case, or the food is too great, or exerts a peculiar chemical action, as with poisons, the organ is changed. The most nutritious food may cause death, and hence the importance of considering every quality of their food. Other substances are also required, such as common salt, so essential to animal life; and metalic compounds are equally essential to the life of plants. But, before we can understand or administer nutriment to the plant, it is necessary to become acquainted with the nature of the soil it grows in, and of air and rain water.

Vegetables depend on the atmosphere for much of their support and vital energy. The chemical constituents of this are known to be the two gases, oxygen and nitrogen, in the proportions of 23.1 of oxygen to 76.9 of nitrogen, in the 100 parts, by weight; or in volume 21 to 79. The properties of these are modified by watery vapor and carbonic acid gas. The latter is discharged from active volcanoes, mineral springs, and the combustion and decay of organic matter. It is detected in most parts of the atmosphere, and it performs a very important part of the process of vegetable nutrition. The annual evolution of carbon from springs and fissures in the volcanic district of the Eifel, has been estimated at 100,000 tons, containing 27,000 tons of carbon.

The final products of all vegetables are carbonic acid, water and ammonia, which last is a compound of nitrogen and hydrogen. Ammonia is supposed to be always present in the air, and is brought down by rain with other matter, as it is always found in rain water. Plants

undergo two processes after death; one is *fermentation* and the other is *putrefaction, decay,* or *eremacausis.* Decay is a slow process of *combustion,* in which the combustible parts of plants unite with the oxygen of the air. The decay of woody fibre in contact with oxygen converts the gas into an equal volume of carbonic acid. During this process water is necessary; alkalies promote, but acids retard it. The woody fibre in a state of decay is called *humus,* and the remaining coal-like substance is called *mould,* the product of complete decay. Decay is the great process of nature by which oxygen, assimilated by plants, is returned to the air. The oxygen of all organic matter is given off combined with carbonic acid. Acids yield more carbonic acid than neutral compounds; while fatty acids, and resins do not putrify.

Soils are considered a magazine of matter which is variously prepared by vegetables for their nutrition. The rich virgin soils of many parts of our country contain a very large proportion of vegetable matter, and hence is called *vegetable mould.* To this is attributable the great fertility of these soils.

Humus, which is the active and important principle in manures, is considered the product of vegetable decomposition. It is believed to be the principal nutriment of plants and to be extracted by them from the soil, and to contain some of their constituents during life. It is a brown substance, soluble in alkalies, but slightly so in water; it is produced by the action of acids and alkalies during vegetable decomposition. It is artificially obtained by treating peat, woody fibre, soot or coal with alkalies by decomposing sugar, starch &c. by acids, or exposing alkaline solutions of tannic and gallic acids to the action of the air. Its modifications are *humic acid, humin, coal of humus,* &c. *Geine* is stated by some to be the basis of all the nourishing parts of vegetable manures. It is the decomposed organic matter of the soil and the product of putrefaction. Humus does not nourish plants in its unaltered state, but as a source of carbonic acid, it is absorbed by the roots, principally when young and destitute of leaves and unable to extract food from the atmosphere. It is a constant source of carbonic acid for the supply of vegetables.

The carbon of plants is derived from the atmosphere and in part from the humus of manures. Plants possess the power of decomposing carbonic acid gas of the air, and of appropriating the carbon to their use. The oxygen of the acid is therefore returned to the air, by which its deficiency, from various causes, is in part supplied. This office is performed by the leaves and green parts of the plant, and this they will do independently of and when separated from the stem. Plants, however, yield to the soil more carbon than they extract.

The life of plants is evidently connected very closely with that of animals. Vegetation may exist without animal life, but the existence

of animals depends on the life and growth of plants. These, therefore, afford both the nutriment for the existence and growth of animals and the essential gaseous element, oxygen, for their respiration. They likewise perform the important office of purifying the air for respiration, by separating from it carbon, ammonia, etc. Animals expire carbon and plants inspire it; plants expire oxygen and animals inspire it. Thus, by this wonderful economy of nature, both are enabled to exist, and the due composition of the air is uniformly maintained.

The provisions of the atmosphere are remarkable. It may be thought strange that it furnishes the great quantity of carbon necessary for the support of the whole vegetable world; yet as it is clearly proved that a column of air of about 2,400 lbs. rests on every square foot of the earth's surface, the 1000th part of this is carbonic acid, 27 per cent of which is carbon. The whole atmosphere, then, contains 3.306 billion lbs. of carbon, a weight more than equal to all the plants and mineral surface of the earth. The superfices of the leaves and other green parts of plants which absorb carbonic acid gas, are deemed to be more than double the whole surface of the globe, and yet, from determinate calculations, they are adequately furnished with all the carbon necessary for the support and growth of the plants.

The inexhaustible oxygen of the tropics, furnished by the inconceivably luxuriant vegetation under a glowing sun, supplies that required by the deficient heat and vegetation of the temperate and frozen zones; while the superabundant carbon produced by artificial heat, etc., at the north, supplies the plants of the tropics. This equilibrium and mutual interchange of local products is most happily effected by the uniform horizontal current of air moving with the revolution of the earth from the equator to the poles, bringing in its passage from thence its superabundant oxygen, and transporting at the same time, the superabundant carbonic acid generated during our northern winters. This acid is greater by night than by day, when it is decomposed by plants. Thus the health of every country is increased by vegetable cultivation.

The remains of primeval vegetation are seen in the vast quantities of peat and coal beneath the surface of the earth; showing vegetable nature to have greatly abounded then and the consumption of carbonic acid to have been incomparably greater than now. It is inferred from this that the atmosphere must now be eminently richer in oxygen than at an early period of the world; as much more so, indeed, as the quantity of carbon and hydrogen which those immense deposits contain. The superabundance of carbon at that time readily accounts, then, for the manifestly superior luxuriance of vegetation. The giant plants of those times, the *palms*, *ferns*, *reeds*, etc., by an immense extension of their leaves, dispensed with nutriment from the soil and resembled, from the small development of their roots, many now which do not

exhaust the soil. Their importance, therefore, at the commencement of vegetation, is now observable. Humus, as a product of decayed vegetables, could not then have existed for their support. But their decay has furnished the soil with vegetable matter, now seen to be essential to vegetation. The leaves, fruits and seeds, but not the roots of the vegetables of a former world, are now abundantly found in coal formations. The roots of trees of later periods are however seldom found wanting when taken from below the surface.

As nutriment for plants no substance can be serviceable or necessary to their growth which is identical with, or even similar in its composition. Hence the sugar, starch, gum, etc., which are the products of vegetables, cannot be assimilated. Aqueous solutions of these substances are imbibed by the roots and conveyed to the various parts of the plants; but they are not assimilated, and therefore afford no nutriment. This is remarkable, since the form of these bodies is most convenient for assimilation and as they contain, in nearly the same proportions, the elements of woody fibre.

The effects of light on vegetation is seen by the arrest of their power of decomposing carbonic acid by its absence. A true chemical process of oxydation is said then to commence by the action of the oxygen of the air on the substances of the leaves, fruits and blossoms and equally on those of the dead or live plant. The green parts of plants containing volatile oils, which are changed into resins by the absorption of oxygen, should, of course, absorb more than those without such oils; and so also with those containing astringent principles, as those of nut-galls, in which nitrogen exists. This has been proved to be so. Some, indeed, are sour in the morning, as the leaves of sorrel from the absorption of oxygen during the night, are tasteless at noon and quite bitter at night. These are deprived of their oxydation in the day time by combining a part of it in their composition. The time required for the leaves to change their color by the effects of the atmosphere likewise indicates the oxygen they absorb. Those continuing the longest green attract the least oxygen in a given time. Hence many retain a durable green color and are found to absorb only about 0.86 of their volume of oxygen, while the poplar absorbs eight and the beech nine and a half times their volume of this element; and these are remarkable for the rapid change of the color of their leaves. They are in a state of oxide, and thus the brown leaf of the oak no longer possesses tannic, nor that of the poplar, balsamic properties. This is true also in respect to the wood of trees.

On the departure of day the carbonic acid and the water absorbed by the roots, cease to be decomposed; they are dissolved in the juices and afterwards escape through the leaves. Carbonic acid is also absorbed by the roots, generally, through the water of the soil; they also absorb air in like manner. The processes of emission and absorption have no

connection with assimilation, nor with one another: the first is a mechanical and the other a chemical process. Thus a cotton wick, in a lamp containing water saturated with carbonic acid, acts like a plant in the night, sucking up both by capillary attraction and evaporating them from its upper surface. Plants in a moist situation give off more carbonic acid in the night than in a dry one; and also more in moist than dry weather.

Plants yield oxygen in greater quantities than they absorb it. Those growing in the bottom of ditches, etc., are perceived, whilst covered with clear ice, to emit bubbles of oxygen during the day. This they derive from the carbonic acid of the water absorbed by them, and the water is supplied with it by the decayed vegetables in the soil. Oak wood is found to contain an excess of one-twelfth of hydrogen; in pines the excess is one-seventh, in *Tilia* and in ebony it is in the proportion to form water. The proportion generally is in relation to the weight of the wood; the lighter kinds containing the most and the heavier the least.

When seeds are planted and the parts designed for the reception of food are absent, the former are employed entirely in the formation of roots; each new fibre, and afterwards each new leaf constitutes a new mouth, lung and stomach. The functions of the leaves are performed at first by the roots; and they extract carbonic acid from the humus of the seed-soil. Sugar and mucilage in the seeds form the nutriment of the young plant and these disappear during the development of the buds, leaves and sprouts. The access of air and formation of carbonic acid is favored by loosening the soil. As the humus is absorbed by the roots, it is replaced by the air, which renews the process of decay and the portions of carbonic acid, till the plant receives food both from above and below, and hastens to maturity.

The size of a plant, it is affirmed, is in proportion to the surface of the organs destined to convey food to it. When the food is more abundant than the existing organs require, the superfluous nutriment is employed in the formation of new organs; so that at the side of a cell, a twig or a leaf, arises another. The amount of nutriment received from the air is in proportion to the extent of the surface of the leaves; and new developments correspond with this amount. When new products are no longer employed, the nutriment they imbibe goes to the formation of woody fibre and other solid parts. The leaves then produce sugar, starch and acids and when the solids are sufficiently extended, the nutriment goes to the production of blossoms. The functions of leaves cease in most plants on the maturity of their fruit and yield to the chemical influence of the oxygen of the air, change their color and fall off. Between blossoming and the maturity of fruit, a transformation of the matter of plants takes place and new compounds are formed in the blossoms, fruit and seeds, while other

substances pass off by the roots as excrementitious matter. This is a chemical process. Elements arrange themselves in new combinations, according to their reciprocal attraction; and under the same conditions, these are incapable of farther change; but the products are as variable as are the conditions. These *transformations* in plants are curious and interesting, but they belong, more especially, to organic chemistry in general.

Each organ of a plant extracts from its food that which is necessary for its own sustenance and other parts, not assimilated, are separated as excrement. This, coming in contact with another organ in its circulation, affords nutriment to it, and so on with a third, etc.; and when incapable of further transformation, it is separated from the system by appropriate organs. Each part or organ is therefore fitted for special functions and one may receive very different substances from another. Thus man may receive carbonic acid into the stomach with impunity, and even with advantage; but to receive it into the lungs, might, as it often does, produce death. So also with other transformations in the animal economy; the kidneys, for example, separate from the body substances containing a large proportion of nitrogen, the liver those with an excess of carbon and the lungs principally those composed of oxygen and hydrogen. Volatile oils and alcohol, which are incapable of being assimilated, are exhaled through the lungs. Superabundant nitrogen is excreted as a liquid excrement from the body and passes through the urinary ducts; all gaseous matter passing through the lungs and all incapable of further transformation, through the intestinal canal. Transformations of the compounds of plants are constantly taking place during their life; and, as a consequence, gaseous substances are eliminated by the leaves and blossoms. Solid excrement is deposited in the bark. Soluble substances containing carbon, are excreted by the roots and are absorbed by the soil, where they decay or putrefy and become nutriment, as humus, for another generation of plants. Decayed leaves and old roots of grass thus become humus. These excretions are most abundant during blossoming and they diminish after the maturity of fruit.

As plants decompose water, they assimilate its hydrogen with carbonic acid and separate oxygen. Thus united, the first two form woody fibre. An acre of ground producing 10 cwt. of carbon, would annually give to the atmosphere 2.865 lbs. of oxygen gas. For every pound of hydrogen thus assimilated, it is calculated 547 cubic feet of oxygen is received; or, in the decomposition of water by plants, one equivalent of the latter to one of the former imbibed. The hydrogen of water decomposed by plants, also goes to the formation of wax, fats, gums and volatile oils, which contain it in large quantities. Vegetables likewise contain hydrogen in the form of water.

In the formation of acids little oxygen is separated. Fruits are

very acid in cold summers, while in the tropics the most numerous trees are those producing oils, caoutchouc, etc., which contain little oxygen. Thus the effects of heat are particularly noticeable upon fruit, both in its nature and quality. The resins of leaves diminish and oxygen is absorbed by ripening fruits in the dark; coloring matters are formed, and some of the acids replace sugar, starch, or gum.

Nitrogen in plants forms an important part, as well also as in rich vegetable moulds. Rain and snow are supposed to be the means by which plants are supplied with this element, through the ammonia in the atmosphere brought to the earth by them. Ammonia is a gas composed of 1 vol. of nitrogen to 3 of hydrogen. This is the fruitful source of nitrogen in temperate climates and *nitric acid* in tropical climates; but the formation of the latter is a product of the former. Ammonia is considered the last product of animal putrefaction, and nitric acid is the result of the transformation of ammonia. A generation of 1000 millions of men, with as many of lower animals dying annually, is considered an adequate source for all the ammonia and nitrogen required for vegetation. Its presence in rain water may be detected by adding a little sulphuric acid to it and evaporating it to dryness in a porcelain basin. The ammonia remaining with the acid is detected by a little powdered lime. The sensation of *softness* in rain water is owing to *carbonate of ammonia*. A portion of the nitrogen thus contained in ammonia is taken up by the roots and produces certain qualities in plants in which it is found, as albumen, gluten, quinine, morphia, etc. Every part of vegetables contains ammonia; the *root*, as the beet, the tree *stem*, as maple, and in all blossoms and unripe fruit. In the form of urine it is one of the most useful manures. Ammonia forms the red and blue coloring matter of flowers. The quantity of food which men or other animals eat is increased or diminished in proportion to the substances containing nitrogen. Nitrogen is believed to constitute one-hundreth part of the weight of grass. Certain soils absorb ammonia from the air, and thus obtain nitrogen. Humus, or decayed wood, affords a considerable quantity of ammonia.

The inorganic constituents of plants are derived from *acids* and *alkalies*, and these form neutral compounds, or *salts*, of various and important qualities in vegetation. Phosphate of magnesia is an invariable constituent of the seeds of all grasses and is introduced into bread and also into beer. Most plants contain organic acids, all of which are in combination with bases, as potash, soda, lime, or magnesia. These are in the greatest quantities in the organs which prepare substances for the food of plants; in the leaves more than the branches and in these more than in the stem. As all plants yield ashes containing carbonic acid, all must contain the salts of an acid in the

form of *carbonates*. The action of all alkaline bases is alike, and all plants must contain them, though it may be in different forms: at least similar quantities of inorganic matter are always found. Corus or vines can thrive only on soils containing potash. Potatoes grown where they are not furnished with earth form a very poisonous alkali in their sprouts. The ashes of the potato is, as compared with oak wood 1,500 to 250, and with pine 83, and rye 440.

By sprinkling plants of certain kinds, or the soil in which they grow, with the juices of others, they manifest the properties of those plants from which the juices are taken. The soil of the hyacinth sprinkled with the juice of the American night shade will exhibit the white blossoms in an hour or two of a red color; but the juice undergoes no chemical change. So with others whose roots are steeped in solutions of some of the salts. Plants have the property, however, of returning to the soil all things unnecessary to their growth, or which are hurtful to their existence. The nature of soils suitable for plants must be selected with reference to the proportion of these salts found in their ashes. Thus on sandy and calcarious soils containing little potash, grass will not thrive. The leaves and small branches contain the most potash.

Some plants are remarkable, particularly those of the grass tribe, the seeds of which supply man with food, in their habit of following him like domestic animals. Some plants require common salt, others require ammonia and are attracted to dunghills. Corn seeds require a large portion of phosphate of magnesia. Hence such plants grow only where these elements are found; and, as no soil abounds with them so much as that where men and animals dwell, there they are attracted. Saline plants, for like reasons, seek the sea shore, or salt springs. Although seeds are carried in various ways to different places, yet the plants will not grow unless they meet with the elements essential to their growth and existence.

The original generation of plants of peculiar kinds in the vicinity of places affording peculiar substances essential to their life, as sea plants near salt works, &c., is not doubted. So also the generation of fresh water muscles in fish ponds, fish in pools of rain, trout in mountain streams, &c., are not deemed improbable circumstances by philosophers. Hence a soil consisting of rocks of particular kinds, decayed vegetables, rain and salt water etc., are considered as possessing the power of generating such particular plants as saltwort &c. Plants thrive best by such manures as have completely lost the property of giving color to water. All plants die in soils containing no oxygen. Stagnant water on marshy soils excludes air, but if the water be withdrawn and free access is given to air, a marsh may be changed into a fruitful field.

In perennial plants a new process of vegetation takes place after the

maturity of their fruit. But after August, the leaves form no more wood, all the carbonic acid being employed for nutriment for the following year; and, instead of wood, starch is formed and diffused by the sap in autumn. The bark of such (aspens, pines, &c.) consequently contains so much starch that it may be extracted, as from potatoes, by trituration with water. The roots and other parts of perennial plants also contain much starch, and sugar and gum are produced from the starch in spring. The juice of the maple is no longer sweet when its leaves, buds, and blossoms have become matured. The branches of willows, contain much starch; and when placed in snow water, they produce roots several times longer than in pure distilled water, in consequence of the greater quantity of ammonia in the former. Part of the sugar of the cane disappears after it blooms, and that of the beet root does not accumulate after the leaves are perfectly formed.

Annual plants collect future nourishment in the same way as the perennial, but they store it in their seeds in the form of starch, gum and albumen, which are used by them in germination, for the formation of their first leaves and radical fibres. The introduction through the roots, artificially, of the same materials that plants use in the formation of their organs by means of the leaves, destroys the plants, unless the process of assimilation can take another form. Sugar, gum, or starch are not therefore food for plants. Thus the production of blood in animals is a vital function by their own appropriate organs, and these admit of no artificial supply of that material.

Seeds are composed of starch and gluten, in the quantities just sufficient for the germ and radical fibre. The starch is converted into sugar and the gluten takes a new form. Both being dissolved by water, they are conveyed to every part of the plant. This conversion of starch into sugar is termed *diastase*, which is a new principle formed at the beginning of germination: it contains nitrogen and furnishes the elements of vegetable albumen.

The sugar of maple trees is not formed in the roots, but in the woody parts of the stem; and the quantity increases until it reaches a certain height, and remains stationary above. At the commencement of vegetation a substance is formed which, being dissolved in water, enters the trunk and converts the starch of the tree into sugar. This is evidently greater than is used by the leaves and buds. Every fibre and particle of wood is surrounded by a juice, while the starch granules and sugar are enclosed in cells: these are supposed to be formed simultaneously. The assimilation of substances generated in the leaves depends on the quantity of the juices contained in the food. When deficient, the substances which do not contain it, are separated as excrement from the bark, roots, leaves, &c. The exudation of gums and sugar by healthy plants is accounted for in this way; and

the processes are analogous in the animal body. It is said that persons living almost exclusively on potatoes pass unchanged granules of starch which is not the case when gluten or flesh is taken in due proportion with potatoes, as the starch has thereby been rendered capable of assimilation. Thus potatoes alone are said to be incapable of affording much strength; but mixed with other substances they are wholesome and nutritious. Hence a superabundance of food, such as carbon, without a due proportion of nitrogen, cannot be converted by plants into gluten, wood, albumen, or other parts of an organ, but is excreted as sugar, wax, starch, oil, resin, &c. When supplied with an excess of nitrogen, the quantity of gluten, albumen and mucilage will increase, and ammoniacal salts will remain in the sap, as in the beet when the leaves are taken off.

Plants growing beside each other are mutually prejudicial to their growth, if each requires the same kind of food; otherwise they may thrive, if in the same state of development. Annual plants are less perfect and abundant by cultivation on the same soil for successive years. Some plants improve the soil while others, and the most numerous, impoverish it; some slowly and others speedily. All this, however, depends on the supply by art of those materials which are the peculiar wants of plants; and this, not by an indiscriminate application of nutriment, or manure, but such as affords in required proportions the component parts of their organs. Their roots, doubtless, imbibe many substances not adapted to nutrition; but these are expelled into the soil as excrements from other parts of the roots. Hence the more of them thus expelled the less fitted is the soil for the growth of plants of the same species. Still, other kinds of plants may require for their growth the same matters which have been expelled, and thus the soil may be made fertile for dissimilar crops. These, again, expel substances which were nutritive to the previous plant and a repetition of such, after a few years, may therefore be advantageous.

The change of vegetable productions appears evident in nature from the well known fact that forests of oak, maple, etc., when destroyed or "worn out" or disappear as they often do in our country from particular soils, are spontaneously followed by trees of the fir tribe; and again, when pine forests are cut down, young oaks or other similar species will shoot up in their places. Excretions from the roots are more abundant in the night time than during the day. Some plants if placed in water impregnated with the excrements of others are impeded in their growth and prematurely fade, while others grow vigorously. The matters thus expelled from the roots are acids, gums, resins, etc., some of which are poisonous and others nutritious to particular plants. Analogous circumstances are very obvious in the animal kingdom. It is worthy of remark, however, that a change

in the nature of the matters expelled is effected by their exposure to the air in the process of cultivation. The nature of the soil also greatly contributes to hasten or retard this change. Flax, peas, clover and potatoes require the longest time in argillaceous soils, for the modification of the matter they expel; but the use of alkalies and burnt lime effects this in a much shorter time; so that the artificial use of certain substances will speedily effect what would require a long time by the unaided processes of nature. This change is supposed to be the conversion of the expelled matter into *humus*. The inundation of fields or meadows is admirably calculated, oftentimes, to accomplish this change.

All plants require alkalies, the *grains* especially in the form of *silicates;* that is, *silicic acid* combined with an alkali; others require *tartrates*, *citrates*, *acetrates*, or *oxalates*, which are also salts formed by the union of an acid, i. e., tartaric acid, acetic acid, or vinegar, oxalic acid, etc., with alkaline bases. The alkalies are *potash*, *soda*, *ammonia*, *lithia*, etc.; the 1st is a *vegetable*, the 2d a *mineral*, and the 3d a *volatile* alkali. *Lime*, *magnesia*, *baryta* and *strontian* are called *alkaline earths*. *Morphia* and *quinia* are alkalies or *alkaloids:* all form salts with the acids in the same manner as *common salt*, which is a union of *muriatic acid* and the alkali *soda*. Silica is an earth in the form of sand, flint, quartz etc., and is most abundant. The woody parts of plants, and the stalks of grains, reeds, etc., have much of it. Silicic acid is the first form taken up by plants for the formation of the wood. Some plants require phosphate of lime, some phosphate of magnesia, and others carbonate of lime. Some require very little of these inorganic matters, as *sanfoin*, *lucern*, etc.; these spread wide their roots, and are much used now to alternate crops. When soil is manured once in nine years, turnips are first sown, next barley, with sanfoin, or lucern for five or six years, then potatoes, then wheat, then barley; and then it is manured and the same crops follow. The importance of spreading light silicious soils with ashes of wood and bones for the purpose of furnishing alkalies, especially phosphates are well known. The ashes of oak are least and those of beech most valuable. Bones afford 10 times more than either. A time will come, says a distinguished chemist when fields will be manured with a solution of glass (silicate of potash) with the ashes of burnt straw, and with salts of phosphoric acid, prepared in chemical manufactories, exactly as medicines are given for fever, etc.

The most important object in cultivating plants is the production of nitrogen in a form for its assimilation by them. The roots, from which the leaves are formed, and the leaves which nourish the woody parts and prepare substances for the composition of the fruit, and also the seeds, abound with it. This is furnished mainly by the atmosphere, as we have said, and plants convert all of it into nutriment

for animals. But the air does not furnish the required quantity. Herbs may grow without it, but no grain; even starch and sugar may be formed, but no gluten; and plants may produce but one seed to perpetuate their kind. An additional quantity enables the plant to attract more carbon from the air and to fix it in its organization. The generation of organic acids is prevented in all vegetables which yield food to man and animals when alkalies are absent from the soil they grow in. These acids are rarely free, but are found in combination with potash, lime, soda or magnesia, as salts, and as before mentioned. These are not found in all plants. Soda is the only salt in saline plants; lime and potash form constituents of grain plants. Some have soda and potash, others potash and magnesia; and the acids vary in a similar manner. The philosophy of cultivation is therefore to give to one plant those substances necessary for its development and to spare those not necessary. Hence the same kind of manure is by no means to be administered to all plants. One may flourish luxuriantly on an arid soil, while another requires much moisture and different quantities at different times. Culinary vegetables contain sulphur, as turnips, rape, cabbage, celery, etc.; hence they thrive best in soils containing sulphates. This, then, must be introduced where it is not, by urine with gypsum, by wool, horn and hoofs. The best manure for wheat is the ashes of straw. Indian corn, poppies, etc., contain little or no potash. Charcoal is found to be of the greatest importance in the cultivation of plants, and especially animal charcoal.

Hydrogen is most abundant when plants begin to secrete oils, camphors, etc., which most abound in the tropical plants, from the influence of the sun. The greater sweetness of sub-acid fruits in those than in plants of colder climates arises from the transformation of more tartaric and other acids into sugar in warm climates. This transformation of substances into the organs of a plant is analogous with that of animals; for the plant must have appeared above ground having previously had all the required elements of its growth to that state in its seed. In the early stage of man's existence, before the organs, like those of plants, have acquired the power to effect this transformation and assimilation, he is provided by his mother's milk with the aliment already, or nearly, elaborated as in seeds.

Leguminous plants, such as beans, peas, etc. best succeed crops of grain, as they contain no free alkalies required and withdrawn by crops of corn. The same plant differs in constitution when grown in different climates. Thus in the warm climates of France, nitre takes the place of sugar in beet roots. These are thus better for cows, as they require more nitrogen and phosphate of lime for the formation of their milk than sheep, which require more sulphur and salt than they, for the formation of their wool. As all kinds of corn contain nitrogen, a full supply of the materials affording it is of great importance to man.

THE ORGANS OF PLANTS.

Seed, Root, Stem, Fluids, Leaf, Flower, Fruit, Appendages, etc.

SEEDS, separated from their parents, are organized and independent living bodies, possessing powers of reproducing their parent stock and their own vital principles. These products, though characteristic of those of their own species, may vary from them in their qualities and from those of the original. For the exercise of these powers they require to be placed so as to receive moisture, air, light and heat, with a proper situation within the earth. The embryo then swells and bursts through its envelopes, extends itself downwards and then upwards, thereby forming a central point from which subsequently emanate other parts. Proceeding upwards with almost resistless power it ultimately appears above ground.

The importance of seeds is readily perceived in the continuation of the vegetable world. In one brief year would be swept from the face of the earth the whole of the annual plants, those most important for the food of man, were not the powers above refered to continued by the seed. Another year would divest us of the biennal plants, the most valuable of vegetables, and within a few years more the whole vegetable kingdom would present a wide scene of ruin. Thus this important link in the chain of vegetable existences is seen to connect and sustain the whole world of animate beings, man, animals and plants. And here our admiration of the wise and determinate laws of Supreme Power, as established and manifested in nature, is most fitly excited.

The structure of seeds.—Seeds present three principal parts, the *eye, husk* and *kernel*. The first is connected to the internal envelope or *ovule* of the fruit by a thread, or *funicle* which is separated when the seed is ripe and exhibits the hole or pore through which the seed received its nourishment, as in the garden bean. The *husk* is the external coat or *cuticle* which is separated by boiling, as in beans, Indian corn, etc. Its importance is obvious from the fact that the kernel which it encloses was at first in a liquid state. The kernel or *nucleus*, includes all within the husk and is composed of the *albumen, cotyledon* and *embryo*. The albumen invests the cotyledon and affords, it is said, the same support to the embryo that the white of an egg does to a chicken. It defends the embryo; and, in germination, serves as its nutriment.

The cotyledons, or *seed-lobes* are *simple* or *double;* they are the fleshy part of the seed. They generally appear above ground as the *seed-leaves*, the first visible parts which nourish the infancy of the plant. When this is done and the young plant can support itself by the

stem and the leaves, the cotyledons wither and die. These vary in different plants; and some, as the *cryptogamous* plants, *mosses*, etc., have none. Those having but *one* are called *Mono-cotyledons*, as the *grasses*, etc.; those with *two* are *Di-cotyledons*, which include the greatest number of plants, as peas, beans, etc., and those having *more* than two are *Poly-cotyledons*, as the hemlock, pines, etc. As the number of cotyledons or lobes rarely vary in the same family of plants, the fact has been adopted by some as the bases of bontanical classification. Some remain below and others appear above ground, by the elongation of the *neck* or *life-knot*, as cabbage, radishes, mustard, etc. By placing a piece of cotton in a tumbler of water with a few seeds of wheat or rye, upon it, the fibres of the seeds will soon be seen to shoot from them perpendicularly downwards in quest of the water, an obvious instinct of the vital parts of the seed.

The embryo, the most important part of the seed, and to which all other parts seem subservient, is the point from which the life and organization of the plant originate. It is plainly seen in some seeds, (di-cotyledons,) as the apple, bean, orange, etc.; but in others it is not easily discovered. It consists of the *plume* and *radical*. The plume *ascends* and displays itself in herbage, while the radical *descends* and appears as roots.

The plume or gemlet is a small thin body, like a feather, in the cavity of the seed-lobe or cotyledon when there is but one, and between the two, when there are that number. It is the bud and all parts proceed from it.

The size, form and number of seeds vary greatly. Some, as the mustard, are globular; others, as the bean, are oblong; others, as buckwheat, are angular. Some plants have one seed, others two, four, or thousands. A corn-stalk will produce 2,000, the poppy 8,000, and a single thistle seed from the 1st crop 24,000, and the 2d crop 576,000,000. The sizes of seeds are 4; *large*, from the size of a walnut to the cocoanut, *middle size*, from a hazel nut to a millet seed; *small*, from those of the poppy to the bell-flower and *minute*, like dust, as in ferns and mosses.



The above cut represents various and peculiar forms of seeds. No. 1 is the Tuberose, 2 Spanish Brown, 3 Acanthus, 4 Euphorbia, 5 Spider Wort, 6 Jonquil, 7 Lily, 8 Sycamore, 9 Comfrey, 10 Borage, 11 Violet, 12 Trefoil, 13 St. John's Wort, 14 Convolvulus, 15 Sunflower, 16 Pompion, 17 Geranium, 18 Pink, 19 Passion Flower, 20 Campanula.

The membranes of the seed, as stated, are three, the *outer* one forms the tube of the flower cup, the *middle* the fleshy part of fruit, as of the apple, peach and melon, and the *inner* with three partitions, encloses the seed, forming, as in the cherry and filbert, *one* chamber and in the apple and pea *two*. The first is thick and stony, and the second thin and husky.

Germination is the evolution of a young plant from the seed. Some seeds, as the coffee, require to be sown on being gathered; others, preserved from heat, moisture and frost, may be long kept. Soil is not indispensable to germination, as mustard germinates on a sponge or moist flannel, and some seeds in water, on glass, bark rocks, etc. Water is indispensable, but too much macerates the seed and it rots, as with the grains, beans etc., in wet seasons.

Air is also essential, as the seed must receive oxygen from it. A seed will not germinate under a receiver exhausted of air; when buried too deep in the soil they receive no air and will not vegetate. Acorns that have lain for centuries, on being ploughed up, have soon vegetated. The *absence of light* is as essential for germination as its presence is necessary afterwards. Heat is likewise requisite. Seeds remain in a torpid state when planted in winter, but the warmth of spring urges them into life; and vegetation is subsequently hastened by increasing it. Germination will be as forward in six hours by increased heat as otherwise in nine. Too great heat, however, destroys the vital principle. Roasted seeds will not vegetate. Some seeds germinate sooner than others, varying from one day to several years. Those of grasses and grains germinate in two days; the peach, walnut, etc., remain in the ground a year. Seeds germinate sooner by being planted on removal from the fruit. Mosses revive on being soaked in water after having been kept 200 years in an herbarium. Some seeds kept dry 1000 years will germinate.

In the germination of the seed-lobe, as with wheat moistened thirty hours, the smooth hard *sheath* becomes downy, and first presents a radicle with one at each side. The *gemlet* appears on the lobe composed of *leafets*. Small *rootlets* spring from the three radicles, and new buds burst upward from the crown of the root. The embryo thus beginning to grow is called the *plantlet*.

Germination with two lobes first presents the radicle projecting like a cone and the naked gemlet appears between the lobes. When planted, or moistened in the dark a day or two, the shell is soft and white, which being stripped off, the two lobes appear with the small gemlet, having yellow leaves and the radicle between them, while the *neck* is united to each lobe by a small stem. The second day after planting, the radicle protrudes as the shell yields; the third day it sends out rootlets, the seed-lobes separate and exhibit the gemlet. On the fifth, the white stem shoots up with the green gemlet on the top.

On the seventh it is much advanced, and on the ninth the plant is completely formed. The lobes then shrink and afterwards decay. The lobes of the horse chestnut do not appear above ground, but send up the gemlet which becomes the trunk of the tree. These organs may be seen in the bean after soaking it a day or two in water and dividing the lobes. A magnifying glass greatly adds to the pleasure of observation in seeds and all other parts of plants.



The accompanying cut shows the two seed-lobes, or *cotyledons* of a seed, with the *radicle* (*a*) and the *plume* (*b*) as with the bean.

The close of the life of annual plants and the suspension of vegetation in woody and perennial plants is signified by the maturity of their seeds. The diffusion of seeds will be noticed in another place.

The principal element of seeds is carbon, which they must part with before they can grow. They therefore convert this carbon into carbonic acid by decomposing moisture or water, with the oxygen of which the carbon forms the carbonic acid, while they incorporate the hydrogen of the water with their tissue. This carbonic acid they give out, when above the surface, in the dark, but by exposure to light the oxygen is given off, and the carbon is again fixed. The water which they absorb also softens and expands the parts and forms the *sap* or *blood,* with which they begin a circulation. Heat sets in motion, within the small cavities, the vital principle which thus beginning to act never ceases till death. All the parts now enlarge, and new ones are formed by a mucilage which seeds form for that purpose. The radicle or root penetrates the soil in search of food, while the young stem rises and unfolds its rudimentary leaves to the light for the absorption of carbonic acid from the air, to form the solid matter of the plant.

The selection of seeds is an important object. It is a law of nature that "like produces like." A disregard, therefore, of a principle so obvious in this particular, must be attended with lasting evils, whilst the contrary must ensure equally enduring and important results. Every variety may be improved, or new and valuable ones formed, by attention to this subject. Let those seeds be selected, then, from the earliest and best fruits. Some plants of every crop will be found to be earlier and superior to others; from such should annually be selected the best seeds, and in time the result cannot be otherwise than plain and important. Peas and beans maturing early from long and full pods on vines growing abundantly, seeds from the stalks and ears of the corn plants selected on the field with like attention; and the best seeds from onions, etc., early ripe and of good form; and indeed good seeds of all other kinds, will insure early and improved

crops. As with the potato, however, we are inclined to think other seeds should not be quite ripe, but should be taken in their fullest vigor a little time previous.

New mode of preparing seeds.—We give the following notice of the discovery of a new mode of preparing seeds, so as to render manures almost if not quite unnecessary. The facts are remarkable; and, if found to be practicable under all circumstances, they will soon effect a wonderful revolution in the arts of agriculture. The withholding of the process by which this may be effected, if what is stated be true, is criminal. However, we give the notice from Prof. Lindley, conductor of the Gardener's Chronicle, London.

(Communication on the Art of Cultivating the ground without Manure.) By F. H. Bickes, Frankfort on the Maine, 1842, p. 31.

WONDERS WILL NEVER CEASE! While our agriculturists are eagerly discussing the comparative advantages of particular soils, and studying the theory of manures as propounded by Sprengel and Liebig, a countryman of these distinguished professors comes forward to proclaim that their labors are vain; for, if we are to believe him, he has discovered the art of growing luxuriant crops on the poorest lands, and without any manure whatsoever; and the cost of the process is so trifling, that for the acre of wheat or maize, it does not exceed five pence sterling; and for rape, cabbage, etc., amounts to only about half that sum. At first we were disposed to consider such extraordinary pretensions as an effusion of quackery; and entitled to little or no credit; but our incredulity has been somewhat shaken by the numerous and respectable attestations which the author has appended to his pamphlet, and which tend to prove that his method has been practiced with success during the last twelve years, in various parts of Germany and Holland. Thus the certificates from Vienna, dated in 1829 and 1830, declare that Mr. Bickes's process, which would seem to consist in some preparation of the seed "renders all manuring unnecessary, is applicable to the poorest soils, and to all sorts of plants, and imparts to them a wonderful degree of vegetation and fulness;" and they gave the results of the experiments in the Imperial Garden, from which it appears that wheat raised from seed sown by Mr. B. had larger ears and more grains than that produced from unprepared seed; that the barley showed ears with four rows and a large number of grains, while that from unprepared seed had only two rows and a smaller proportion of grains on each stalk; and the Indian corn exhibited a larger number of much stronger and thicker heads.

Some plants of the sunflower, treated according to Mr. B.'s method, grew to the height of ten to eleven feet, with woody stems of eight and a half to nine inches in circumference. Ten or twelve potato plants, of a large yellow sort, called Marburger, yielded each, on the average, thirty good sized tubers, with stem and branches seven feet long; and

maize, which grew partly singly and partly in rows, had from two to five, and in some instances, as many as eight and nine heads. We are further assured that they were raised in ground but partially dressed, and in the midst of tall weeds! The trials of this method in Holland, made in the summer of 1834, were attended with results not less astonishing: prepared wheat and rye, though sown thick, gave from 50 to 60, and even 80 stalks from one grain: and a plant of barley bore 8 large ears. Buck wheat rose to 4½ and 5 feet; flax had 4 and 5 stems from one seed, and Indian corn grew from 9 to 10 feet in height, with 4 to 5 heads from a single corn. The green crops were equally luxuriant.

Liebeg's Agricultural chemistry, teaches us that *Ammonia* is the great stimulant to the growth of plants. At one of the late agricultural meetings in London, Dr. T. C. Jackson suggested that the seeds might be coated with some gummy substance, and then rolled in Guano, enough of which would readily adhere, to produce all the effects ascribed to those foreign prepared seeds,—the new plan being a secret.

A mere tea-spoonful of guano applied to a newly struck rose cutting of a few inches in length had been sufficient, the following spring, to produce a bush of some six or eight feet in height. It is the received opinion that the nourishment of vegetable life is derived from the atmosphere.

Guano is the product of innumerable birds on some of the Pacific islands, found 50 feet deep, and is now largely exported to this country and Great Britain for manure. It is exciting much attention among cultivators here. The effect of a small portion on some plants is astonishing. Roses not more than 4 or 5 inches high when the guano was applied soon ran up to 3 feet, while those cultivated in the common way, in pots, have not exceeded one foot. Some geraniums have produced leaves 7 feet long and 8 inches broad. Other not less remarkable effects have been noticed.

Roots.

As soon as the stem rises to the surface and the leaves begin to draw nourishment from the air, the roots cease to enlarge, but they extend themselves in length, like icicles, by additions to their points. They are then spongy and are called *sponglets*. The extreme points possess the principal absorbing and conveying power: they both draw up useful and convey off useless matter. They change their direction and spread through the soil like cattle in a pasture in search of food, but they cease to work when the seed-lobes or leaves cease to act or consume. Their size and force of absorption are in proportion to the required food of the plant, being most active in summer and more or less torpid in autumn and winter. They still work, however, during

winter and store up food in the plant for returning spring; at which time the new shoots of the plant are in proportion to the quantity of food thus stored up. Hence the longer the period of rest, the more vigor there will be in the plants and shoots on returning warm weather.

The quality of the nutriment which roots select is according to the wants of the plant. Thus some select one kind and some another, and hence the importance of providing the soil with such substances as the plants are known to require. Those things which are poisonous to man are generally so to plants. Thus opium, or arsenic, presented to their roots will destroy them as soon as it would man. The power of life in roots does not become so soon expended as in bearing branches. If half a root becomes poisoned the other half will throw off the poison.

The length of roots varies in different plants: they are generally proportioned to the extent of the branches. They are more extended in open fields than in woods and forests, and more on the windward than on the sheltered side of a tree, in order to secure the tree more firmly. The roots of palms and pines are comparatively short. An oak, but 6 inches high will, in a rich deep soil, put out roots 4 feet long. Roots are not only designed to supply nutriment immediately to plants, but to store it up for future plants, as with the potato, etc. To avoid light the roots of some plants placed on glass will send them inward and they accordingly grow best on dark substances. Tuberous roots and bulbs or corms are called *subterranean stems*, of which are the *tuber*, as in the potato, arrow-root, etc., and the *corm*, as in crocus, saffron and creeping-root.

Roots consist of 2 parts, the *caudex* or body, and the radicles, or fibres, which are capillary tubes that absorb nourishment and convey it to the main branches, or the body. Between the body and stem is the *neck*, *root-stock* or *life-knot*. Roots are *annual*, coming from the seed in spring, and dying in autumn, as the pea, bean, cucumber, etc.; *biennial*, producing no flowers the 1st season, blossoming the next summer and then dying, as the onion, beet, carrot, etc.; and *perennial*, living many years, as asparagus, rose, geranium, trees and shrubs. Some perennials become annuals by planting them in colder climates.

The neck being a vital part, the others may be injured or cut away yet, the plant will grow. The crown or neck of a radish in water will throw out vigorous leaves in a warm place, when divested of all other parts. The radicles are to the caudex or body of the root what the branches are to the stem. They are the chief support of the root. The herbage of a young radish with all parts except the radicles in water will soon perish, but if the radicles be immersed and the other parts remain out, it will continue fresh. Roots shun the light as carefully as leaves and shoots seek it.

Forms of roots. The following are examples of some kinds of roots, as characterized by their forms.



Fig. 1. *Fusiform*, or *spindle-shaped*. It is *simple* or in one piece as beet, carrot, radish, &c., or *branched*, at the lower part, as in the mandrake, and consists of the *body* and *radicles* or fibres which absorb nourishment and are therefore the true root. In perennial plants these fibres are renewed annually. They are produced early in spring; the best time therefore for transplanting trees is in autumn. The effect of cultivation on many acrid and poisonous roots is to render them wholesome and nutritious. Thus the wild parsnip and carrot have large stems containing an acrid juice, and their roots are deleterious, hard, and dry. This root may be *abrupt*.



Fig. 2. *Abrupt*, or *premose* root, signifying bitten, as plantain, violet, etc., devil's bit—said to have been bitten off by the devil, out of spite on finding it a useful medicine. These roots are not, however, abrupt until after they are a year old, being at first spindle-shaped the lower part then decaying and separating; after which the lateral branches shoot out.



Fig. 3. *Branched root*, the most common of all, and belonging to trees and many annual and biennial plants, all terminating in radicles. It resembles the branches of a tree, from which it differs but little, except in growing under ground. Many will grow on being pulled up and the tree inverted, bearing branches, leaves and fruit, while the tops shoot out fibrous roots, as with the willow, a limb of which being bent and both ends inserted in the ground, will each take root, and branches will spring from the circle. The limbs of shrubs being thus bent down into the ground and after a time cut off, form a new plant. Trees are divided and multiplied in China by removing in the spring an inch or two of the bark of a limb. The naked place is then covered with moist earth, secured by a slip of matting. Over this is suspended a vessel of water with a small hole in its bottom which keeps the earth moist. In the autumn small roots will have shot into the earth when the limb is sawed off just below this place and set in the ground and continues to bear fruit. Dwarfs of the smallest size may thus be formed.



Fig. 4. *Fibrous root*, common to most of the grasses and many annual plants. It is calculated for a light sandy soil, being thread-like and presenting numerous points for absorption.



Fig. 5. *Tuberous* or *knotted root*, consisting of knobs connected by fibres. Some are perennial, as the Jerusalem artichoke or annual, as the potato. They are hard and fleshy as the potato, etc., the source of moisture, food and vital energy. The Orchis, etc., have two tubers. In some they are crowded (grumose) as in the Orphis or *fasciculated*, as in asphodel, etc.

Necklace, or moniliform root is a tuberous root regularly connected by fibers, like a necklace. Sometimes the small tubers grow in clusters, or are scattered on the radicles like grains, and hence are called *granulated roots*, as many of the grasses, wood sorrel, etc.





Fig 7. *Handshape*, or palmated root, oblong fleshy tubers, parted like fingers, as orchis, dahlia, etc.



Bulbous roots are of several kinds.

Fig. 8. *Solid bulb*, uniformly fleshy, as turnip, crocus, etc. But one root is attached to a plant, Many inhabit sandy barren places.



Fig. 9. *Tunicated root*, consisting of many concentric layers, one over another, as onions.



Fig. 10. *Scaly bulb*, consisting of scales connected at the base, overlaying one another, as white lily. Some small bulbs are connected in the same coating as in the garlic.

Bulbs are analogous to buds or *turions*, and are reservoirs of nourishment for the germ and future plant during the winter. Sometimes they grow on the stalk and take root, as the orange lily. Bulbs generally die before winter. They are important articles of food, generally. Tulip roots are thus used in Italy. Bulbs are dried in the sun, baked, powdered and made into bread, or eaten boiled or roasted. The bulb of the onion, leek and garlic, are well known.

Bulbous roots belong to the great divisions of mono-cotyledons with one seed-lobe, as the hyacinth, lily, etc. Bulbs growing on the stem or branches, take root on falling to the ground, producing its offspring alive, thus being *viviparous* instead of producing by seeds, or *oviparous*.



Roots of this kind appear to have for their object the protection of the young plant from wet and cold.

Fig. 11. *Creeping or Repent root*, creeping horizontally or just under the surface of the ground. Bulbs sometimes die after they have blossomed, and others are formed

which produce plants, as with the orchis tribe. Bulbous roots are taken up once in two years, as new ones formed under or over old ones are too deep in the soil or too near the surface. These are bulb bearing roots, the fibrous part being truly a root. They continue the old ones, while a new plant is only produced by seeds.



The cut shows a bulb-bearing root also a sectional view of the same cut vertically showing the embryo and the seed-leaf enclosed. If continued long however, by means of bulbs or grafting, the plants degenerate, as by old age. Such being the case with the potato, new roots are produced from the seed.

The names of plants are often derived from the form of the root. These forms are various, but they are precisely such as are required for the growth and situation of the plant. Some are suited for growth in water, and others are adapted to bark, stone, etc., as with parasites growing upon other trees, as is common in the tropical climates. Those growing without roots are called *air plants*, the stems of which inhale but do not exhale. These are found on rocks, etc. while some will live suspended from the ceiling of a room. The virtues of plants are most concentrated in winter; hence that is the best season for collecting them for medicinal purposes. The roots grow most rapidly in autumn. As the juices of plants condense in the roots at that time, the sun being less powerful to attract them upward and the air more moist than in summer, they throw out fibres at intervals, as in mint, strawberry, etc. Some are very tenacious of life, and any part having a joint will throw out new roots and form a perfect plant. These roots are often very troublesome to agriculturists. They have a sweetish taste, and are occasionally used as food. They are collected and thus used in parts of Europe. By interlacing the soil they give to it great permanency, as on the coast of Holland, they are therefore well calculated for such as are light and sandy. Thus, too, a small reed, though otherwise unimportant, has saved the most valuable soil of Egypt from being washed away by the Nile



This cut represents another form of the creeping root.

There are some plants which throw down roots from the surface of the water on which the leaves float. These constitute the whole of the plant, as the "Duck's Meat," represented in the cut.



There are numerous other kinds of roots which manifest various habits, and which are variously adapted to the peculiarities of their situation. Some plants have no roots, deriving their food from air or water.

The Stem of Plants.

The stem of plants, as soon as nutriment is conveyed to it by the roots, is rapidly forced upward. Its cylindrical form is thought to be much in consequence of its seeking so earnestly to reach the surface, being impelled upward by the sap and, at the same time, pressed upon by the surrounding earth. Its points, or opening bud, are the *plumule* or *plume*, which is fed by the matter stored in the seed leaves, and furnished to it by the radicle. This matter is not exhausted before the proper leaves appear to furnish the required nutriment from the air. When the stem first appears it is weak and brittle; and the first object of the leaves is to supply its exterior part with a woody substance, composed of fine tough tubes that pass downwards through the cellular tissue, giving it strength and flexibility; and also to form the bark according to the wants of the plant and the abundance of the leaves it is to possess. The woody matter first forms a ring within the exterior, leaving a space in the centre for the pith, and thereby forming 3 parts, the *pith*, *wood*, and *bark*. The wood is formed perpendicularly and the bark and pith horizontally; and the last two are connected by cellular tissue. The wood part when wounded is healed by the cellular or horizontal parts, forming granulations which coalesce. Some plants suffer great lacerations, but readily close the wounds.

The membranous parts of plants are the *cellular texture* and the *vascular texture*. The first is composed of small cells, like honey-comb, or like the cellular system in animals containing the fat of the body. In vegetables the cells contain resinous, oily or saccharine juices, and sometimes air only. They compose the principal part of the pith of plants. This texture also abounds in fleshy and pulpy fruits, tuberous roots and stems of grasses. It is situated in the bark under the exterior, or *cuticle*. Being filled with juice, it gives to plants their color, which is mostly green, in the same manner as the texture beneath the cuticle of the human skin gives color to man. These juices also give color to flowers and leaves. Cells are principally filled with water in young plants, while old ones are often empty.

The vascular texture is composed of tubes, like the blood vessels of the human body. These are opened at both ends and lined with a cellular substance. They extend throughout the plant, transmitting air, etc., to its various parts. Those which are *entire*, or without perforations, convey the proper juices containing oils and resinous matter, and those which are porous partake of the character of the cellular parts.

The spiral and annular vessels are so called from their form, the 1st resembling that of a screw, and the 2d that of a ring. The spiral are formed of a fine thread, turning from right to left, and in the an-

nular the tube has the appearance of being composed of rings. There are also *moniliform* vessels, resembling a string of beads, which connect larger ones and convey sap from one set of vessels to another. Mosses and lichens have no vascular system, being composed of the cellular tissue altogether. Vascular fibres compose roots and the stem; and these may readily be split longitudinally, but with great difficulty horizontally, having to cut across the tubes.

The glands of plants are internal vessels which effect changes in their fluids. They are situated in the cells and on the borders of spiral vessels. The *nectaries* of flowers, which secrete or make honey, and the small bodies secreting poison at the base of the stings of plants, are external glands.

The bark of plants, as we have intimated, has two distinct parts, the one internal, woody and cellular, and the other external and cellular. The most internal part is called *liber*, and the external the *cortical*. These are independent of each other, the 1st being mostly horizontal fibres, or *medullary rays*, and the 2d is perpendicular. In plants acquiring an age beyond a few years, the wood is divided into two parts, the *heart-wood* and *sap-wood*, or *alburnum*. The first, or central part is generally of a brown or dark color and the other, or external part is softer and of a yellowish color. The internal was at first the external part, it having been changed by age from the hardening of the matter within its tubes. The external part, or alburnum, being the young wood, its matter has not become solid.

The stem consists, then, 1st, of *wood*, the oldest part of which is *heart-wood* and the newest *alburnum*, through which the sap *ascends*; 2d, of *bark*, through which the sap *descends*; 3d, of the *pith*, the central portion of the horizontal part, and 4th of the *medullary rays*, which connect the rind or external part horizontally with the pith and maintain a communication with it. In some plants these are mixed; and in the annual and herbaceous they are least distinct. The differences appear by comparing the oak, the cabbage and asparagus.

The fluids of plants. These are 1st, the *sap*, or ascending fluid, 2d, the *cambium*, or descending fluid, and 3d, the *proper juices*. The sap is inodorous and limpid, being imbibed through the pores of the roots from the earth in the state of water holding in solution earthy salts and other substances, all of which are converted into sap. This ascends through the woody part to the branches and into the ribs and veins of the leaves, entering all the vessels and cells of the plant. Thus ascending it is always in action, though its energies correspond with the season and age of the plant. It is facilitated by heat, though in very warm weather it is often slow, because of the absence of moisture in the soil. The leaves then eagerly absorb it and revive, if supplied artificially. The development of buds is dependent on this circulation and the storing of nutriment for them on the return of spring.

In the imperfect plants which, having no vascular system, as the lichens, mushrooms, etc., no sap ascends, as they imbibe fluids from the air.

The cause of the circulation in opposition to gravitation, is not well understood; it is, however, the apparent result of mechanical or capillary action, promoted by heat. This is the popular opinion at least; but it fails in dead plants, as the sap will not rise in them on the principles of capillary attraction. It will be seen, therefore, that what we have said before on the circulation and functions of plants generally should elicit further inquiry, and that we should not be content with the summary declarations of those predetermined to admit no identity between the functions of plants and animals. Indeed, the process is undoubtedly like that of the circulation in the animal system, to which, throughout vegetable physiology, we observe a close functional analogy, however much some may affect to discard the striking resemblances. On arriving at the leaves the sap is exhaled in the form of pure water, while the important substances it contained are deposited in the leaf. The process of perspiration may be plainly observed in the grasses and other plants. Thus about 2-3ds of the sap absorbed by the roots is exhaled; the remaining 3d containing the nutritive properties distributed through it being retained. This would appear like the chyle of the animal blood, and the leaves as peforming the functions of lungs; the difference being that plants in light inhale carbonic acid and exhale oxygen, which is reversed in the dark; while animals inhale oxygen and exhale carbonic acid. The carbon of the sap is further fitted for nourishment by the the absorption of oxygen through the leaves during the night, to convert the carbon into carbonic acid. The same process it does also by decomposing the water absorbed by the roots, to obtain its oxygen.

The cambium is the sap after its elaboration in the leaves, by which it is rendered suitable for nourishment. It then descends through a system of vessels between the liber, the internal layer of the bark, and the young wood, or alburnum, contributing at the same time to the formation of a new external layer of wood and internal layer of bark, as well as the formation of new buds and roots. The descent of the sap and the progress of these important functions are arrested by cutting through the bark, when the plant dies. The *proper juices* are all the fluids except the sap and cambium, and are oils, gums, etc. They are, in fact, secreted by glands from the latter, as the many fluids, such as tears, saliva, etc., are secreted from the blood by the glands of the animal body.

The epidermis, cellular integument and cortex constitute the *bark.* The first is also called the *cuticle,* as the scarf or outer skin of animals is called. It varies in thickness in plants, from the delicate covering of the rose-leaf to the ragged bark of the oak or walnut; or like the

cuticle of the hand and foot, or covering of the ox or tortoise, compared with the membranes of the eye, etc. It peels off in the birch, etc., as with animals, not possessing, as with them, vitality. It is designed to protect the plant from external injury and to regulate through its pores, perspiration and absorption, as with animals, yet admitting light and heat, but excluding injurious substances. The cuticle of rye, wheat and some grasses is valuable in the arts, especially in the manufacture of bonnets, for which the cellular texture is removed, leaving the cuticle only. It contains, in many plants, silex or flint, as in the reeds and scouring rush. It is the least destructible part and often has upon it wool, or down, like that of animals and for like purposes.

The cellular integument or texture is next beneath the epidermis, or cuticle, and contains a resinous fluid which, in young plants, is commonly green. In this are the glands for decomposing the gases and other materials for the growth of the plant. It is the "true skin" and the depository of color as in animals and man, alike in the white Caucasian and the black African. In fruits this integument has various colors. It dies on the surface like the cuticle. It often cleaves off, but is renewed by the cambium, or descending sap.

The cortex is directly beneath the cellular texture. It is formed of longitudinal fibres, or *cortical* vessels which, forming every year, are plainly seen in annular deposits, or rings, when a tree is cut down: by these its age is determined. The particular qualities of plants reside in their cortex. The resins, astringent principles, and the aromatic oils are found in it. The inner part, called the *liber*, is the seat of the principle and vital functions of the plant. The name is from a book, the leaves of which it resembles in its annual layers deposited by the descending sap. It is a kind of net work resembling cloth. As a new layer is formed, the old one of bark is pushed outward which readily loses its vital principle and forms an inert crust. It is of liber that cloth is made, as with flax, the paper-mulberry, etc. This being the vital part of the plant, it cannot be destroyed with impunity. The most recently formed part of the liber, between the wood and the bark, remains inactive during the repose of vegetation. After effecting the development of buds and the formation of new wood and bark it hardens, as in previous years, and loses its vital power. Herbs and shrubs generally have a larger portion of pith than trees, and young vegetables more than old ones. The *medullary* rays diverge from the centre to the circumference. They are fibrous textures interwoven in the wood; and new buds appear to originate where they terminate on the exterior.

The wood consists of the *perfect wood* and the alburnum or sapwood, which is the outer new part, at first soft, but annually becoming hard. As with perfect wood, new layers are formed yearly. Most of the sap

ascends through it. The perfect, or heart-wood, is darker than the sap-wood and is the principal part of the tree, as used for timber, being the annual hard concentric layers and longitudinal woody fibres. The age of a branch is determined by the layers at the base of each. In the increase upwards of a tree, the sap having extended as far as possible, forms there a cone, at the summit of which a bud is formed. From this springs a new shoot; and a new layer of alburnum is, of course, organized, which becoming perfect wood the following year; another new bud is again formed on the cone of the last; and so on, one annually encompassing another.

Plants are distinguished on account of different modes of growth, as *mono-cotyledonous*, arising from seeds with *one* cotyledon or lobe, and *di-cotyledonous*, those from seeds with *two* cotyledons or lobes. The first are also called *endogenous* (inside growers) the wood augmenting annually by *internal* additions to their centre, thereby pushing to the surface previous annual formations. The second are also called *exogenous* (outside growers) the woody matter being increased annually by *external* additions. All trees and shrubs of the U. S. except the few palms of the south and some grasses, as the sugar cane, Indian corn, etc. are of this latter kind—*di-cotyledons* or *exogenous*.



This cut represents the formation and structure of the outside growers, which constitute most northern plants, and shows the concentric circles and medullary rays radiating from the centre.

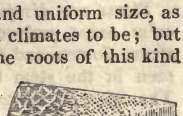
These are important distinctions in vegetable physiology, and are of recent origin.

The mono-cotyledons, or endogenous plants, seldom have any bark distinct from the other texture; no liber or alburnum in concentric layers, nor medullary rays, as the pith extends almost to the circumference, instead of being confined to the centre, as with *di-cotyledons*. The number is however small here, as we have stated. The cut is a representation of the internal structure of this species of plants.



The appearance of the wood shows it to be composed of longitudinal fibres. Each appears to vegetate separately, and the principal part of them seem to be pressed outward by new ones in the centre. The old fibres thus pressed, are thick and compact near the exterior.

It is apparent that this mode of growth is favorable to the extension of plants logitudinally, i. e., for a straight, slim and uniform size, as we find the palms, sugar cane, etc., of the tropical climates to be; but it is unfavorable to their growth in diameter. The roots of this kind of plant are mostly fibrous.



A sectional view of the stem shows the cellular tissue to occupy three-fourths of it, and to be encroaching upon the vascular system near the exteri-

or; thus growing inwardly from the exterior, and therefore *endogenous*. Such continue to grow in height without increasing their diameter, as we find in the long canes or reeds. These are of the great division *Mono-cotyledons*, while the other division, *Di-cotyledons*, or *exogens*, are the reverse of this in their growth. These divisions should be remembered. In the latter the vascular system begins to organize around the pith and continues to form outwardly by annual layers of liber deposited by the cambium flowing downwards between it and the bark. These concentric layers are seen near the base of the tree, when cut.

The circulation, then, is the passage upward of the original sap or watery fluid from the roots, through the new wood beneath the bark to the leaves where it is changed by the action of the leaves and the air. From thence it flows downward through the liber, a part passing off horizontally to the centre and depositing a portion of its solid matter; hence the oldest or heart-wood, has the greatest portion of solid substance. The sap being first water, holding in solution earths, salts, etc., it takes up the mucilage and other soluble matter it finds in its passage and increases in density until it reaches and is distributed among the leaves. The attraction of the leaves is thought to be the cause of the flow of the sap. It begins to flow in the spring from the ends of the branches; but this is not the *motion* of sap which continues in winter. This is the filling up of the system effected by the attraction of the roots, and not by the exhalations from the leaves. It is therefore probable that, as the leaves do not exhale or attract in winter, the sap does not then flow as in summer.

The effects of injury to the central wood or pith, are not great, it being often destroyed, as we see in old trees, without affecting the stem. The mere bark or rind may also be destroyed without permanent injury, but the liber and alburnum cannot be injured without danger to the plant. In some cases of emergency plants will alter their functions and circulate their fluids laterally instead of horizontally. Many curious experiments have thus tested the pliancy and restorative powers of plants. *Girdling* or *ringing* a tree, usually destroys it; but it may be saved from death by taking a circle or section from the limb of a similar tree and adapting it carefully to the wounded edges and binding them with grafting clay. The application need not encompass the whole trunk, as the union by a portion will preserve the whole tree, and the other part will be covered in time.

Stems are divided into 7 classes, the *caulis*, or proper stem, the *culm, scape, peduncle petiole, frond* and *stipe*. When plants have no stems, flowers and fruits grow from the tops of roots. The caulis is seen in the stem of the tree and common shrub, or annual plants. The culm, or *straw* is the stem, as seen in grasses, grains, bamboo, sugar cane, rushes, etc. It is *without knots*, as in the bullrush; *jointed*, as in Indian corn and wheat, and *bent* as in fox-glove and

some grasses. *Scape* is a stalk springing from the root and bearing fruit and flowers, but not leaves, as cowslip, dandelion, lily of the valley, etc. Plants with scapes are often called *stemless*. *Peduncle* is a part of the stem, bearing fruit, but not flowers nor leaves, as in the plum and peach. When there is no peduncle the flowers are called *sessile* or *sitting*. Its length bears a relation to the species.

Petiole or *leaf-stalk*, is also a part of the stem, supporting the leaf, and is commonly green. The leaves and flowers are thus generally supported by distinct foot-stalks, but sometimes one supports both. *Frond* is applied to the leaf of the *cryptogamous* plants, or those without visible sexual organs, as the fern where the leaf grows from the stem; *Stipe* is the stem of such plants as the fern, the stem of the mushroom, and the column supporting the down of the dandelion, etc. These are a division of the stem, as *boughs* are of branches.

Branches. These arise from buds and proceed from the trunk, differing little from the stem except in age. They are *simple* or *divided*. They grow with or without *order*; are sometimes *opposite*, *alternate* or in rings round the trunk, as in the pine. They are *erect*, as in the poplar, or *pendent*, as with the willow. As they grow older they branch more and more until they become pendent.

Bulbs often grow from the axils of the leaves of stems; and, like bulbous roots, contain the germ of new plants. They are buds of a large and particular kind; magazines in which are stored nutriment secreted by the leaves. Being the parents of other individuals and the origin of branches, they are the most important organs of plants. Soon after their formation some separate themselves from the stem, fall to the ground and take root. The *banyan tree* is remarkable for throwing down stems which, taking root, form a small forest under and around it.

Stems are divided into the two great divisions we have elsewhere spoken of, as *exogens*, (growing *externally*,) and *endogens*, (growing *internally*. Stems are also *woody*, as birch; *pithy* as elder; *branched*, as oak; *naked*, as saltwort; *hollow*, as fennel; *simple*, as lily and tulip; *passing through a leaf*, as woodbine and *twining*, as the hop and bean. The stems of herbs are generally soft and watery, bearing flowers once and then dying.

The spuce between the collar of the root and the first leaf or bud, and also between two or more leaves, is sometimes called the *bole*, and the whole is called the trunk. The running stem is termed a *runner;* a short runner that does not take root is called an *offset*, and a larger one as in cucumber, a *vinelet*, and a small stem running laterally from a root is a *sucker*. When a stem bears permanent, or perennial, branches, it is called a *tree*; when these branches arise from the root, the plant is called a *shrub;* when small and much branched, a *copse shrub;* and when furnished with branches, not permanent, it is called

an *under-shrub*, and when the stem is not woody, dying down to the root annually, it is called an *herb*.

Appendages of plants. These are *stipules, thorns, prickles, glands, scales, stings, tendrils, pubescences, bracts, hairs, etc.* They are found on various species of plants; and, although their functions are not perfectly known, yet no one can doubt their importance in vegetable economy. *Stipules* are membranes, or leafy scales, commonly in pairs at the base of the leaf on either side of the foot stalk, in most plants, as in the sweet pea. *Prickles* arise from the bark and are generally found on the stem, as in the rose; sometimes on the base of the leaf, or petiole, as in the raspberry, on the calyx, or on the berry, as in the gooseberry. They are *straight, hooked, or forked. Thorns* grow from the woody part, where they remain when the bark is stripped off, while prickles come off with the bark. They often disappear when the plant is cultivated. Some think them bulbs which by cultivation form branches. *Glands* are small globules containing a liquid secretion which, it is thought, give the odor of some plants. They are sometimes at the base of leaves, sometimes *in* the leaves, as in the lemon and myrtle, or they may be *on* other parts of leaves, and also on the ends of hairs, as in the moss rose, nettle, etc. *Stings* are hollow and pointed, giving pain by an acrid liquor which they eject when pressed. *Scales* are found on all parts of plants resembling the scales of a fish; on calyxes of compound flowers, on the envelops of grasses and sustaining the stamens and fruit of the pine, oak, etc. *Tendrils* are weak stems that clasp other bodies for support. They commonly rise from branches, but rarely from leaf or flower-stalks. They serve for roots in the ivy, trumpet flower, etc., and for shade in the cucumber. They twine in pea-blossom plants; and in the preferences and movements of tendrils generally, great apparent intelligence is manifested. *Pubescence* is the downy, silky or woolly parts of plants. With a magnifying glass they present interesting features and resemble the clothing of animals. When in rows they are called *fringes*. On mullein leaves they look like flannel or the felt of a white hat. They assist evaporation and protect leaves from the cold. Dresses are made of them in some places. They are of various forms. *Bract* is a floral leaf situated near the flowers. In the sage they much resemble the leaves, and they are often mistaken for the calyx. They are *green* or *colored, deciduous,* or *persistent*.

The Leaf.

This is an expansion of the bark of the plant and consists of cellular substance, with ribs and veins running through it, the whole being covered by a green skin, or *cuticle*. The cellular tissue consists of woody matter springing from the pith and liber. The tissue of the

veins is arranged in two layers firmly united, the superior part arising from near the pith and the inferior from the liber. The former connects the leaf and wood and the latter the leaf and bark. Thus as the sap ascends through the alburnum and wood and then descends through the liber, the upper system of veins communicates with the *ascending* and the lower with the *descending* current.

The skin is filled with small cavities, at first charged with fluid and lastly with air. It is hard and thick in hot climates and thin in moist and shady places, but it varies according to species. Some leaves contain more *parenchyma*, or cellular texture, than others, and are accordingly more juicy and pulpy. The cells vary greatly in size; in some leaves they may be seen with the naked eye. They secrete fluids like glands and communicate with the vascular system.

The leaf breathes and perspires through innumerable small pores, or *stomates*, which are larger or smaller according to the above circumstances, being large and abundant in moist shady places, so as to obtain liquid aliment, and also for exhaling and inhaling gases. Leaves present to the air a more extended surface than all other parts of the plant, and are thus of the greatest importance in deriving nourishment from it, and giving off gases which are useless or prejudicial to the plant.

The natural habits of the plant may be known by a microscopic examination of the leaf-skin, or epidermis and its stomates. Those with a thick skin and few stomates will naturally inhabit dry places where liquid food is scarce, while those with a thin skin and numerous and large stomates belong to humid climates and damp soils: intermediate structures are governed accordingly. But the relative size of stomates is generally a more important mark than their number. The number of these in an inch of skin on some leaves, aloes for example, is 45,000, and in some others 70,000. Still, the size of those most numerous may not be equal to those of a less number.

The functions of leaves thus show them to be the *lungs* and *stomach* of plants, having a system of *veins*, etc. Their skin is an extension of the skin of the stem, which, in some plants, performs the functions of leaves when leaves are wanting. *Respiration, perspiration* and *digestion*, as performed by the leaves are not less essential to the life and growth of plants than are the same functions to men and lower animals. The primary agent in the performance of these functions is solar light. This, in striking the leaf, causes a decomposition of carbonic acid and the extrication of nitrogen, with an insensible perspiration.

Foliation is the manner in which leaves and flowers are enclosed by the scales of the bud, which is so varied that the families of plants may be distinguished by it. Plants which are destitute of leaves are called *aphyllous*; i. e., wanting a leaf. To the various characters of

leaves much importance is attached in determining the species and other botanical characteristics of plants. In some the species is decided entirely by them.

The periods of leaves are three. The *seminal leaves* come up from the ground with the plant, and after nourishing it, they die. The *primordial leaves* immediately follow the seminal and are like them in form, position and size. The *characteristic leaves* are found in the mature state of the plant. These changes do not however always take place, the latter being in some plants the only ones which appear.

The forms of leaves are various and important in classification. A leaf commonly consists of the *leaf-stalk* and *disc*. It is *simple* or *compound*. The simple is when but one grows on a leaf-stalk and compound when there are several, as in the rose. The *obicular*, or round leaf, has its *petiole* or base inserted into the centre and is *peltate*, as the *nasturtion*. *Reniform*, or kidney-form, as the ground-ivy: it is *crenate*, with margin scolloped and *ciliate*, fringed with hairs. *Cordate*, or heart-shaped, with *accuminated* or acute point, *serated*, or with notched margin, like saw-teeth, as in the aster. *Ovate*, or egg shaped: this is also *abovate*, *oval*, or *eliptical*. *Lanceolate*, as in the peach. *Linear*, as in Indian corn and the grasses, and *sheathing*, or enclosing the stem. *Deltoid*, or triangular, as in the lombardy poplar. *Sagittate* or arrow-head shaped, as sagitaria. *Acerose*, or needle shaped and *clustered* as in the pine; it is *subulate*, like an awl, *rigid* and *evergreen*, as with trees common to the mountains. *Pinnatified* and *pectinate*, like comb teeth and *lyrate*, with a broader segment. *Palmate*, or hand-shaped, as passion flower, segments oblong like fingers. *Digitate*, finger-shaped, distinct leafets, without palm, as the horse chestnut. *Cannate* the bases of two united, appearing as one leaf. *Lobed*, deeply indented at their margins and three or four lobed, according to number. *Sinuate*, margins with deep round divisions. *Emarginate* with slight indentation. *Flabelliform*, or fanshape, as in some palms: such leaves are sold in China for fans. *Stellated*, or whorled, as in a ring around the stem. *Tubular*, of which there are numerous varieties, as the onion, etc. Some are hollowed out at the base and contain fluid, deposited during rain. The pitcher plant of Ceylon is a remarkable example of the tubular shape, being a cylindrical cup six inches long filled with pure water, with a lid opening and shutting according to the weather. *Primate*, wing shaped, leaf stalks opposite each other. *Binate*, two leaves springing from the petiole. *Ternate*, three leaves arising from the petiole and *biternate*, *triternate*, *decompound* and *tricompound*. There are also other forms, even to the burden of the science, which are not at first important to the general reader. To those minute in their enquiries and making large collections of leaves and flowers a more extended work will be necessary.

The circumference of the leaf presents variously formed outlines, *tips* and *margins* which will be recognized by the observer without any other description than that found in the glossary.

The insertion and direction of leaves in regard to the stem will also be seen to be characterized by numerous terms, most of which are burdensome, unless the subject is studied minutely.

The size of leaves greatly differs. They increase in magnitude towards the tropics, where some are of immense size. Those of the Talipot-tree in Ceylon, it is said, will cover 20 men each. Numerous and important uses are made of them, especially the palm leaves, in warm and rainy latitudes. The size of the leaf, however, bears no proportion to the tree or shrub, as seen in the oak and burdock.

The color of leaves, though generally green, is beautifully variegated in autumn, yet never so beautifully as the corolla of flowers. Green is most agreeable to the eye; and it is remarkable that leaves are so constituted as to reflect that color, mostly. The changes in this color are effected by the combination of oxygen with iron, as in the colored petals of flowers.

The duration of leaves is characterized as *caducous* when they fall off before the end of summer; *diciduous* when they fall at the beginning of winter, as with most leaves in our climate, or 30 or 40 degs. from the equator; *persistent* when they remain on the tree or shrub during the changes of season, as with the pine, box, etc., and *evergreen* when they preserve their green color throughout the year, as with pines and most resinous trees. These leaves are indeed annually changed, but the young leaves appear before the old ones decay. Leaves, in the torrid zone, are generally persistent and evergreen; but, if the plants be removed to a colder climate, they become annual and lose their foliage annually, as with the passion flower, a native of a warmer climate.

The defoliation of plants is the falling off of the leaf. It is attributed to the death of the leaf and the cessation of the vital principle in the parts to which it is attached. On a tree struck by lightning, which does not possess the power to throw off the leaves, they adhere to the dead branches. The accomplishment of the important functions of the plant, such as the formation of its buds, flowers and fruit, and the exhaustion of its energies, with the occurrence at that time of frosts and winds, are the general causes of defoliation. The leaves of some trees turn red, others brown and others yellow about the middle of autumn, when they present to the eye, in an American forest, the richest scene imaginable. Some few plants have no leaves, as the mushroom, indian pipe, etc., nor is it known how the deficiency is amended. In the renewal of the leaf a leaf-scale appears at the base and also a floral leaf in flowers.

The anatomy of leaves. The skeleton or frame of a leaf may be

observed in a dead leaf for some time exposed to the weather. In this will be seen a rib running midway through it and numerous fibres branching from it towards the margin. The skin may be removed by boiling it slightly and rubbing out the cellular texture, leaving the different vessels or the vascular system entire. They then present the appearance of veins and arteries, being tubular, etc. This will now be more apparent by immersing it in a colored fluid which will penetrate the fibres. The skin or cuticle which covers and protects the vascular system, is sometimes covered with down or hairy glands for security against variations of the weather, and sometimes with a clear varnish which protects the leaf against too much moisture. This is common in parts where there is much rain. The leaf is said to be *regose* when the cellular tissue abounds and the upper surface swells while the under surface becomes depressed, and *cancellated* when there is little cellular tissue and the vascular system presents the appearance of net-work. The rib proceeds from the upper end or the petiole of the leaf-stalk through the middle of the disc; and the branches proceeding from this are called *riblets*. Grasses have the simplest form of leaf. Beside the mid-rib, some leaves have two, others one at each side and are called three-nerved leaves. The grass leaf has one, the ivy leaf two and the grape leaf three. *Simple* leaves have one, the main rib with its branches; and the branches of the compound leaves divide the disc into many forms.

The physiology of leaves is of the greatest importance to plants, and, indeed, to the whole animal world. The upper part of the leaf performs the respiratory functions: it is of a deeper green than the under part; but when the upper part is placed on the surface of water, this color diminishes and the leaf withers. The under surface, however, with like circumstances, will preserve the leaf fresh for many days. Plants almost invariably present their upper surface to the light, at which time it gives off oxygen by decomposing the carbonic acid which the plant receives through the roots and also that received from the air through the leaves, the carbon remaining and ultimately forming starch, gums, sugar, and other solid parts. But in the dark, instead of oxygen, carbonic acid is given out, so that during the day leaves yield oxygen to the air and withdraw carbonic acid, while during the night they give out carbonic acid, but no oxygen. The labor thus performed during the day is generally in proportion to the intensity of light and the circumstances of their situation. Some plants close there leaves at a certain period of the day and open them at another, as with the sensitive plant; and most of them shrink, fold their leaves or corollas and cease to act after the disappearance of the sun, but resume their task on the apearance of light in the morning. This has been termed the *sleep of plants*, which is doubtless as necessary to them as sleep to animals. Other than solar light will

awaken plants to action as shown by placing the sensitive plant in a dark cave and illuminating it with lamp light; when it will suddenly unfold its leaves and again close them on withdrawing the light. The irritability of leaves is a remarkable phenomenon, as observed in their motions on presenting the hand or other substances to them. This is particularly notable in the sensitive plant. These leaves seem to be much agitated, as if afraid of injury under such circumstances.

The perspiration of plants is more abundant than in animals, though in neither do we see it passing off except in cold weather. A root placed in a bottle of water will withdraw it all and give it off in an insensible perspiration. Thus a sun flower will perspire in a warm day 30 ounces, or, as is said, 17 times more than a man; but in the night time little or none. The stem of a vine cut off near the head, and a bladder secured tightly around it, will in the sun soon send off sap enough to swell and burst the bladder. Plants, however, absorb moisture during the night by their roots and are increased in weight in the morning. Those in the shade, or in damp places, hence absorb more than they loose, and the result is to render their parts soft and watery.

The power of leaves in sucking up moisture is evidently very great; as, upon a lofty tree, they act upon the roots at 3,000 times the distance of their length. Roots placed in a warmer situation than that of branches, absorb liquids faster than the leaves consume them, and the sap often bursts through the stem and eventually destroys the excitability of the tissue. In reversed situations the leaves, not receiving sufficient sap from the roots, will die, the fruit will fall off, or the flowers be unable to set it. One of the leaves of a branch taken off, if kept constantly wet, will supply another below it with moisture, even though the communication be intercepted. The powers and properties of leaves and other organs of plants, vary much, however, in their specific nature and in their phenomena.

Buds.

Buds are divided into *leaf-buds*, containing the rudiments of leaves without flowers; *flower-buds*, containing the rudiments of one or more flowers, folded over each other in scales, and *mixed-buds*, containing both leaves and flowers. These, closely examined or cut through, present beautiful incipient forms in progress of development. Some consider the *bulb* and *turion* as a species of bud. *Leaf-buds*, in most respects are like bulbs; they are commonly oval and are composed of tough scales closely fitted together and covered with a gummy resin, with a moist and downy substance between the scales for the protection of the embryo from the cold; while the external scales are dry and hard. The embryo is thus often protected for years, even in

water. Herbs and shrubs commonly unfold their buds the same season and are without scales, while those of trees are not perfected in less than two, and often not less than several years. In the midst of summer, vegetation seems to cease, but no suspension takes place, as plants are then busy in storing up nourishment for and in forming new buds. Thus the future leaves are safely secured from the coldness of the season, so as to take the place of those which have disappeared.

Budding implies the expansion of the leaves or flowers in the spring. The first point in the plant which gives rise to the bud is the *eye;* when this swells and becomes apparent it is the *button,* and when this unfolds it is the bud. Some suppose that the eye is formed late in the summer and that the young shoot forces itself through the bark, when the young leaves become chilled. They then contract, harden and form protective scales which, in like manner, seek the light and air. There are no buds scales in warm climates or in hot houses, as they are not needed. Few trees in the United States can endure the cold without them. The scales generally fall off as the interior parts enlarge by growth. The manner in which the young leaves are folded or rolled within the bud, varies greatly and is, withal, very curious.

Frondescence is the period in which any species of plants unfolds its leaves. Linnæus thought that when the buds of the birch tree opened, barley, etc., should be sown; and the American indians believed that when the young leaves of the oak were of the size of squirrels's ears, Indian corn should be planted. The orange tree, like most tropical plants, never will form scales for the protection of its buds; but there are some plants more yielding in their habits, and which ultimately conform to the necessities of colder climates; the horse chestnut for example. Monocotyledonous plants rarely produce annually more than one bud. The great source of vegetable life is the sap; this is carefully secreted for the growth of the buds during the winter. The axils of leaves or the extremities of branches and stems, where they appear, are at the most suitable places for the accumulation of nourishment. Branches originate from buds. Thus we see the wise provisions made for the renewal of branches, leaves, flowers, fruits, etc., and the continuation of the species.

The flower-bud is usually at the end of small and short branches and is used in grafting, which is done by cutting into the bark of some other tree and placing one or more buds into the place cut; when in due time, it will bear the fruit of its parent stock. The mixed buds produce both flowers and leaves, as the lilac. Leaf-buds planted in the earth put forth roots and flourish, but flower-buds perish when placed in the earth.

Bulbs are formed at the base of leaves where they store up nourishment for subsequent use. The base leaves are formed in layers, or concentric plates, as in the lily, snow drop, hyacinth, etc. These

plates expand into leaves and the flower stalk in spring. Small bulbs are formed into bulbous plants on the crown of the root, which enlarging and becoming detached, form perfect bulbs that shoot up leaves and flowers.

Fruit.

Fruit is the immediate product of flowers. The fertilization of the seed having taken place, the pistil, or the pistil and enveloping parts, grow, change their form and appearance, obtain new color, texture, flavor, etc., and ultimately become fruit. Two essentially different kinds of fruit are formed by different processes in flowers. The pistil in one instance grows separately from the envelopes, which fall off, and the fruit is formed by a change and enlargement of parts of the pistil; this is called *superior* fruit. In the other case the pistil and envelopes grow together and the fruit consists of a change and enlargement of the whole flower; this is called *inferior* fruit. The essential difference between the two is that the superior fruit is attached to the branch alone by the pistil, while the inferior adheres by the base, both of the pistil and all the envelopes. The qualities of fruit, however, are not significant of these terms; they are not indeed used by many botanists, those of *calyx-adherent* and *calyx-free*, being substituted. Among the superior are the *strawberry, raspberry, peach, plum, apricot, cherry, grape*, and *fig*; and among the inferior are the *apple, pear, quince, medlar, currant, gooseberry, melon* and *cucumber*.

Fruit is a kind of branch, it being an advanced state of a flower, which is a kind of branch; and it has the same kind of organic connection with the plant as other branches, requiring, like them, to be supplied by it with food. Its interior, however, not being woody, but pulpy, it more readily leaves its parent stem. The inferior fruit consists of a less number of leaves than the superior; and, as the supply of food to the plant and its attractive force is in proportion to the number of leaves, the inferior is more attractive than the superior, and consequently it is less liable to fall off. The pistil of the superior fruit being unprotected, it is more exposed to frosts and other changes of the atmosphere, and is more liable to suffer therefrom than the inferior. There are, however, some variations from this rule.

Fruit, like leaves, has power to form and elaborate secretions, but it contributes little to the plant, as its powers are exerted in perfecting itself; still, some kinds do form wood. The object of fruit is evidently the protection and nourishment of the seed for the perpetuation of its kind; and, for this purpose, its fluids are mostly consumed. This it attracts from neighboring parts and, in doing so, often destroys fruit in its vicinity, if it be more healthy and vigorous; and the weaker fruits, as we often see, shrink and fall off.

The food of fruit, employed in its maturation, is derived in part from the atmosphere, but mostly through the leaves, which, after receiving it from the roots, prepare it for the food of the fruit. All circumstances, therefore, which impair the health and action of the roots and leaves affect, in like manner, the fruit. It is necessary, also, that the leaves should be contiguous to the fruit, in order to furnish it readily with its requisite food. Hence it is seen that fruit on naked branches will not grow, and that leaves immediately over the fruit prove of the greatest advantage to it. A full supply of nutriment from these sources is therefore the only assurance of good fruit, however valuable its kind may be. It sometimes happens that an undue accumulation of sap proves injurious to the products of plants, especially tuberous plants. The potato, from this circumstance, is liable to the disease called *curl*, owing to the inspisated state of the juices. Fruit oftentimes fails to elaborate the juices within it, or receives more water than it passes off through its small pores, and it therefore becomes "watery." But when its stomates readily give off superfluous aqueous particles, it becomes hard and dry. A superabundance of water always retards or prevents ripening. The quality of fruit, depends much on the quantity and quality of its juices. It is certain that these undergo a great alteration in the fruit after coming from the leaves, as the juice of the leaves of many species are acrid and even poisonous. Thus the leaves of the peach, the fig, etc., are very dif ferent from the fruit.

Light and heat have an immediate and very important influence in the maturation of fruit. The valuable qualities of fruits, natives of warm climates, certainly could not be developed in this climate. The production of sugar and many rich flavors are obviously the effect of a bright light and a high temperature, while, under diverse circumstances, the same fruits become acid and unpalatable. The sweetness of ripe fruits depends on their sugar. This contains much carbon, the superfluous oxygen which formed with it the vegetable acid having been expelled by the action of heat. Besides, vegetable acids, at a high temperature, may enter into combination with gums, starch, etc., and thus form sugar much more readily than at a low temperature. Hence acid fruits become much sweeter by cooking.

The seeds of fruit, during ripening, attract from it matter for their organization, and serve at the same time to correct some of its qualities. They are lodged in and are attached to a soft part of the interior called the *placenta*, the most absorbent of tissues, and are enveloped by the parenchyma of the fruit. They are dry when ripe, and their interior is filled with starch, earthy matter, etc. Being enclosed by an indurated envelop, these substances will remain undecomposed and possessed of the vital principle for hundreds and even thousands of years. Melon seeds and rye have germinated when 40 years old,

beans at 100, raspberry at 1,700 and some seeds, it is said, taken from the Egyptian tombs and pyramids have also germinated. The difference in these seminal properties depends much, no doubt, on the chemical character of their parts, the starchy parts being most durable, while the oily are easily decomposed. Warmth and moisture are the principal cause both of their germination and their death. So long as their carbon remains they no doubt possess germinating powers. The effect of water is to decompose their constituents, its oxygen combining with their carbon and forming carbonic acid, which is a process of germination, and which they are incapable of renewing. The health and vigor of the plant correspond with the seed; hence the importance of selecting such seeds for cultivation as will insure good fruit.

Fruit is composed of two principal parts, the *pericarp* and *seed*. The former is the seed vessel and signifies around the fruit. It is of different kinds. Some fruits are *capsules*, opening by the separation of *valves*. Within are cells or carpels containing the seeds; so that all which is not seeds belongs to the pericarp. On cutting a germ horizontally *ovules* are seen with their outer covering or *ovary*. The ovules, at first scarcely perceptible, become enlarged after fertilization by the pollen, and the embryo and other parts appear and form the seed. The ovary which enlarges with the ovules is furnished with glands that secrete the juices necessary for the growth of the ovules; and as it becomes more mature, it is called the pericarp. This, in its growth, becomes woody or pulpy. Pulpy pericarps absorb oxygen gas and throw off carbonic acid; and saccharine juices are elaborated in their cellular integuments. At their period of decay they pass through a slight fermentation, the juices become sour, the pulp is decomposed, and putrefaction follows. When the germ is fertilized, the parts of the flower not necessary for the growth of the fruit commonly fade, wither, or fall off, while the pericarp and seed continue to enlarge until perfected. All fruit has once been the germ of a flower. Fruit, as generally understood, is pulpy and used as food, but botanically, it is the seeds and pericarp of all plants. Its size bears no proportion to the vegetable producing it, as seen by the acorn of the oak and the pumpkin of the small vine.

Fruits are divided into 3 parts, in some pericarps, 1st the *epicarp*, the skin or membranous part surrounding it; 2d, the *sarcocarp*, the fleshy or corky part, covered by the epicarp; 3d, the *endocarp*, a membrane of the fruit lining the internal cavity and forming the partitions and cells. The skin of the peach, for example, is the epicarp, the pulpy substance absorbing the juices is the sarcocarp, and the dry and tough shell enclosing the kernel is the *endocarp*. The pericarp, in most fruits, consists, 1st, of *valves*, external pieces forming the sides of the seed vessels. If the pericarp is composed of but one valve, as in the chestnut, it is termed *univalved*, if of 2, as in the pea pod, *bivalved;*

if of 3, as the violet, *trivalved*; if of 4, as in the stramonium, *quadrivalved*. *Sutures* or seams are the lines uniting the valves which separate at maturity, as with the two valves of the pea pod. *Partitions* divide the cells and are *longitudinal* or *transverse*. *Column* or *columella* is the axis of the fruit, the central point of union of the partitions, as in the core of the apple. The *cells* contain the seeds: they seldom vary in the same genus of plants. The *Receptacle* of fruit is the part of the pericarp to which the seeds are attached until maturity and which through its connecting fibres conveys food to the seeds from the pericarp. Some plants have no pericarp, as with the grasses and compound and labiate flowers: the seeds lie in the bottom of the calyx, which performs the office of the pericarp.

The division of fruit, by Linnæus was into 9 classes, viz: 1. The *capsule*, a little casket, opening by pores or valves. The seed cells are *one-celled*, *two-celled*, etc., according to number. It rises from the receptacle and has the seeds attached all around. In one-celled capsules this is wanting. 2. *Silique*, a two-valved and two-celled pericarp, with the seeds attached alternately to opposite edges, as radish, mustard, etc. *Silicle* is a "little pod," and is the distinction in the class *tetradynamia*. 3. *Legume*, a pericarp of 2 valves, with the seeds attached to one *suture*, as the *pea*. Plants producing the legume are called *leguminous*, and the term *pod* is generally applied to the pericarp. 4. *Follicle*, a one-valved pericarp; the seeds are loose or not attached to the suture, which opens longitudinally on one side, as in the milk-weed. 5. *Drupe*, a stone fruit, without a valve. It contains a nut or stone in which is a kernel or *nucleus*. It is mostly moist and succulent, as the peach, cherry, plum, etc. *Nut* is a seed covered with a shell, as the walnut, almond and chestnut. 7. *Pome*, a pulpy pericarp without valves, but with a membranous capsule and numerous cells, containing seeds. It has no external opening, or valve. The apple, pear, quince, and gourd are examples. 8. *Berry*, a pulpy succulent pericarp, the seeds having no covering but the pulp, in which they are dispersed promiscuously, or placed on receptacles within it. A *compound berry* consists of single berries: each is a grain containing a seed united, as in the mulberry. The orange and lemon are berries with a thick covering. The strawberry is commonly called a berry, but it is a pulpy receptacle with naked seeds. The fig is a juicy calyx with numerous florets in its cavity, each with a pulpy calyx investing the seed. 9. *Strobilum*, a catkin hardened into a seed, as in the pine: it is called an aggregate pericarp; and some seeds of the fruit are enveloped by scales. It is of various forms. A *pepon* is a fruit like the melon, cucumber, etc. A berry is said to be *proper* when formed of the pericarp, and *improper* when formed of other parts.

Classification of Fruits.

The fruits or pericarps of all phenogamous plants have been divided by Mirbel into two classes, viz., *gymnocarpes*, those not covered or masked by an organ concealing their character, and *angiocarpes*, those which are covered by an organ concealing them. These two classes are subdivided into orders and genera.

Order 1st, *carabrulares*, class 1st, *gymnocarpes*, (fruits not covered.) Simple fruits without valves, never opening spontaneously and including fruits of the grasses, and *syngenesious* plants, etc., genera *cypsela*, pericarp 1 celled, 1 seeded, adhering, seed erect, *monocephalous*, etc., as the lettuce, oyster-plant, dandelion, etc. Gen. *cerion*, embryo on side of persisperm, 1 cotyledon, large and fleshy, as fruit of indian corn, grasses, wheat, rice, etc. Gen. *carcerula*, as buckwheat, rhubarb, elm, etc.

Order 2d, *capsulares*, simple capsules opening at maturity, free, single ovary, etc., Gen. capsule as in the lily, 1 or more cells, etc. Gen. *Legume*, irregular bivalve, monocephalous, free, 1 cell, embryo with 2 cotyledons, as the bean, pea, cassia, etc. Gen. *silique, bivalved*, seeds attached to upper and lower valves, as white mustard, etc. Gen. *Pyxides*, 2 valves opening like a box, as bachelor's button, etc.

Order 3d, *dieresila*, simple fruits, many symetrical carpels opening at maturity, as seed of nasturtion. Gen. *cremocarp*, ovary surmounted with 2 styles, 2 cells, 2 seeds, embryo with 2 cotyledons, as seeds of carrot, parsley and other umbelliferous plants. Gen. *Regmate*, many seeds, 2 valves opening with a spring, as euphobia. Gen. *Dieresil*, variable, as geranium, hollyhock, etc.

Order 4th, compound fruits, from ovaries bearing styles. Gen. *Double follicle*, as milk weed. Gen. *Etairon*, many seeds, as ranunculus, anemomone, as monk's hood, &c.

Order 6th, *Drupaces*, simple, succulent fruits, containing a nut. Gen. *Drupe*, pericarp woody, or bony, as nuts, and fleshy as peach, or pulpy as cherry.

Order 7th, simple succulent fruits, many separate seeds. Gen. *Pyridion*, fruit regular, pericarp round and fleshy, several cells, each with 1 or more seeds, embryo with 2 large cotyledons, as the pear and apple, seeds in 5 carpels or cells. Gen. *Pepo*, 3 celled, many seeds, regular monocephalous fruit, as water melon, cucumber. Gen. *Bacca*, a berry many seeded, without capsules, as pericarp of orange, whortleberry, current, barberry, potato, grape, etc.

Class 2d. (*Fruits covered*) 5 genera. Gen. *Strobilum*, or *cone*, carcerular fruits, concealed by scales, as pine, juniper, pine apple. Gen, *Calybion*, as the fruit of the oak, (in a scaly capsule) beech, yew, etc. Gen. *Sycone*, as ambara, etc. Gen. *Sorose*, fruits united in a spike and covered with succulent floral envelops, as mulberry.

These are barely the names of the orders and genera. A more minute description would be burdened with terms not important, it is thought, to the general reader.

The capsule, as we have said, consists of one or more cells which are shown in the accompanying cut. These discharge their seeds spontaneously by the division of the valves, on becoming dry. Some are discharged through small pores, and others are dispersed by the pericarp acting like an elastic spring and throwing them in various directions, as with the *touch me not*, etc.





This cut exhibits the form of the pericarp of the primrose, with the same cut in two, showing the seeds within and the manner of their growth on the receptacle.



This cut represents a *two*, or *bivalved*, pericarp which is a *siliqua*, or pod, in which the seeds are arranged alternately along the edges of the partition separating the pod by the two sutures, as in the wall flower, cabbage, turnip, etc.



This shows the form of a little pod, or *silicle*, and differs from the siliqua only in its size and shape, as in the satin-flower and shepherd's purse.



This is a representation of the *legume*, a kind of pericarp with two valves, but without a partition, or dissepiment. It bears its seeds along one suture only and is the well known pod of the pea, bean, etc., all composing the *leguminous* plants of the 17th botanical class, and one of the largest and most useful tribe.



This pericarp is a *univalve* consisting of but one valve or piece, and is called a *follicle* or *bag*. The seed grows on the receptacle or the margin of the suture; and the pericarp bursts and discharges its seeds, as seen in the cut, and as with the periwinkle and milk weed.



This cut represents a *drupe* or *drupa*, a stone fruit with a fleshy or pulpy pericarp, without valves. The stone has a seed or kernel, as with the plumb, cherry and peach. The *nut* is a bony fruit with one cell generally, but it has no fleshy pericarp as with the last. Its exterior envelop is hard, with valves, as with the walnut, or membranous as with the hazel-nut. With the acorn the envelop is but partial.



The *Bacca*, or berry, is a succulent fruit, as elsewhere noticed. It never opens by valves, like the capsule: the currant and gooseberry are examples. This and the last cut show the fruit divided with the kernel and seeds within.



A *compound berry* is here shown composed of many small berries or grains, each with a seed.



This is a *pome*; a fleshy pericarp without valves; but, unlike the two last, it has a capsule enclosing its seeds. The apple, pear and quince are well known examples; but these pericarps vary greatly in shape and quality.



The cone, or *strobulus*, is a hardened capsule, or seed vessel, covered with scales, as in the pines, cypruses, &c. The alder and birch present an aditional capsule; and in the willow the capsule is bivalved and suspended by a stem distinct from the scales.

The pappus, or seed down is generally attached to seeds wanting a pericarp, as with the compound flowers, dandelions, thistles, &c. In the first the pappus is elevated on a stype above the seed; and in the second it is sessile or sitting on the seed.

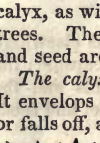
Flowers.

These are an important organ of plants. They are designed for the protection of fruit and the reproduction of their species by the agency of seeds, and are the means, also, by which these species are determined by botanists.

They consist of several parts or organs, differing much from one another, but collectively, of the *floral envelops* and the *sexes*. The first consists of the *calyx* or flower-cup, the *outer green envelop* and the *corolla*, blossom, or *inner envelop*, the *colored part of the flower*. Each part of the envelop consists of parts or leaves, which, in the calyx, are called *sepals* and in the corolla *petals*.

One or both of these envelops is often wanting in plants; in the calyx, as with the tulip and lily; and in the corolla, as with most forest trees. The *sexes* consist of the stamens, pistils, &c. The pericarp and seed are also distinct parts of flowers.

The calyx is an expansion of the outer bark of the flower-stalk. It envelops the corolla before it expands, and subsequently remains, or falls off, as with the poppy. It consists either of one leaf, or sepal,



and is called *monosepalous*, or of several sepals, and is *polysepalous*. This cut shows a monopetalous calyx, or flower-cup, *five-parted*, as in burglass, tobacco, etc. When surrounded by another it is *double*, and when belonging to many flowers it is *common*. It is composed of 3 parts; the *tube*, rising from the base; the *throat*, the part above the tube, and the *mouth*, the upper expanded part. It is a *curtain* in mushrooms, etc., and a *veil* in grasses, grains, etc. The scales are *husks* of one piece in rye and many pieces, as in panic-grass.

The position of the calyx in relation to the germ is important in marking the distinctions of genera, or natural families. It is *superior* when at the top of the germ, as in the apple, etc., and *inferior* when below it, as in the pink. It is called *caducous* when it falls off before the flower expands, and when it falls off with the corolla it is *deciduous*, and when remaining till the fruit is mature it is *persistent*, as with the apple, pear, pea, etc.

The divisions of the calyx are 1st, the *perianth*, the real calyx, or *cup*, as in the rose: this is double in some, as the hollyhock; 2d, *involucrum*, as in the carrot, etc., in which the calyx does not



embrace the flower, like the perianth, but is distant, surrounding the stem and consisting of small leaves, as in parsnip, dill, etc. It is *universal* when surrounding several umbels, and *partial* when surrounding the peduncles of the flowers; 3d, *ament* or *catkin*, which is a calyx of many scales, along a thread receptacle, each scale protecting one or more stamens, or pistils, as with the oak, chestnut, poplar, etc.; 4th, *spatha* or *sheath*, encloses a flower at first and then bursting the flower stalk that grows above it, as the wild turnip, onion, narcissus, etc., displaying a *spadix* on which, in some flowers, the stamens and pistils grow, or which bear fruit, as in the palms.





5th, *glume*, or husk, is the calyx of the grasses and grains, composed of one or two pieces, or valves. The *beard* or *awn* belongs to the glume. Of the awn of wild oats is made an hydrometer to indicate moisture and dryness. The middle part of the awn is twisted like a screw and one end cemented to a circular plate marked into degrees, while a bristle is attached to the other end to serve as an index; and the whole is covered with a glass. The awn untwists and moves in one direction in damp and rainy weather, but moves in a contrary direction when the atmosphere is dry. The corolla is a part of the calyx in grasses.



6th, *calyptra*, or *veil*, which is the cap or hood of parts of the mosses, as at *a*.

7th, *volva*, the wrapper of the head of fungous plants. All these are different kinds and forms of calyxes, and these are various in form and situation.



The corolla, corona or crown, is the continuation of the inner bark of the flower-stalk. It exhales carbonic acid, but not oxygen. It is the seat of all the beauty and variegated colors in flowers. Before blossoming it is folded in the calyx, after which it is the flower-bud. A flower is said to be *petalous* when with the petals or leaves of the corolla, and *apetalous* when without them. These are *definite* when not more than 20, and *indefinite* when more than 20. When composed of 1 petal the corolla is *monopetalous*, and when of more than 1, *polypetalous*. The



1st consists of the *tube*, the lower part; the *throat*, the entrance to the tube, and the *limb*, the top border of the corolla. In the 2d the petals consist of the *lamina*, the thin marginal part, some times *entire*, as with the rose, or *notched* or *crenate*, as with the pink. The *claw* is the lower



part of the petal inserted on the *receptacle:* it is *long* or *short*. The corolla is *regular* when petals correspond with each other, as in the rose and pink, and *irregular* when they do not, as with the pea and labiate flowers.



This cut shows the form of the corolla and calyx as in the cowslip. *The form* of the monopetalous corollas may be *bell-formed*, 5 parted, and *superior*, as the blue-bell, etc., with the calyx; *funnel-form*, as the morning glory; *cap-shaped*, as tobacco; *salver-shaped*, as jasmine; *wheel-form*, as mullein, potato, etc.; *star-shaped* and *pitcher-shaped;* also *tubular*, as in primrose.

Labiate corollas are like the lips of an animal; they are *personate* with the throat closed, or *ringent* with it open, or *anomalous*, as in the fox-glove.

The form of the polypetalous corolla may be *cruciform*, like a *cross*, with 4 petals, as radish, cabbage, etc.; *caryophyllous*, 5 petals, terminating in a long claw and inclosed in a calyx, as the pink; *lilaceous*, with 6 petals, of a bell-form, as the lily, tulip, etc.; *rosaceous*, rounding petals, without claws, as the apple, rose, etc.; *papilionaceous*, from the butterfly, with a banner, 2 wings and a keel, as the pea. Without any of these forms a corolla is *anomalous*.

The *nectary* is an organ of flowers which secretes honey. It is a cavity in flowers provided with glands, wherever the honey is found, which differs in different flowers. There is a difference of opinion as to the purpose for which honey is secreted. Its extraction, however, seems not to affect the flower or the plant.

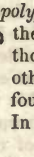
The *odor* of flowers arises from the volatilet oils made by or secreted in the corolla. The process is facilitated by heat, but the oils are more readily dissipated by it. They are more abundant in the morning, especially if the air be moist. The nature of odors differ essentially in conformity with the peculiarities of the organization, and the food whichwantsextract from the soil. Some are poisonous, fetid, or narcotic, while others are most agreeable; yet these qualities vary with individuals, some being pleasant to one and offensive to others, showing a difference in our own organization corresponding with that of plants.

The Sexes.

These consist of stamens and pistils. The pistils generally stand in the centre of the flower with the stamens surrounding them, except when the sexes are on different flowers and each sex is central in its own flower. They are indispensible to the perfection of fruit. They generally stand on the same flower enclosed by the same envelop, or upon the receptacle. They are on different flowers arising from the

same root in the class *Monœcia* and on different flowers from different roots in *Diœcia*.

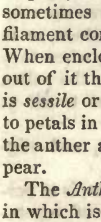
Stamens take various positions in regard to the pistils, without however varying much in the same family of plants. When inserted upon the pistil, as in *umbeliferous* plants, they are *epigynous;* when under the germ, as with cruciform plants, they are *hypogynous* and when inserted on the calyx and around the germ they are *perigynous*. Stamens are commonly double, equal, or half the number of divisions of the carolla in *monopetalous* flowers, though never more than 20; but, in the *polypetalous* flowers they may be greater. Stamens alternate with these divisions of the corolla when equal in number; when double those divisions, half are in the intervals of the divisions and the other half are before the lobes of the carolla. Those stamens, found without anthers, or *barren*, are generally before these lobes. In the cut, *a* is the *anther* and *b* the *filament*.



Filaments are parts of the stamens. They are long and slender, as in pink, or short and thick, as in the tulip, are commonly smooth, but sometimes bearded, as in mullein and downy, as in spider wort. A filament commonly supports one other, but sometimes two or more. When enclosed in the tube of the corolla they are *inserted*, but when out of it they are *exserted*. When the filament is wanting the anther is *sessile* or *sitting* in the throat of the flower. The stamens change to petals in double flowers, or disappear, as the result of cultivation, and the anther also. No perfect fruit is produced when the stamens disappear.

The *Anther* is a small knob on the top of the filament, having cells in which is the powder *pollen*.

Pistils are upright stems varying in number, like stamens, in different plants. They consist of 3 parts, the *germ* or *ovary*, the *style* and *stygma*. In the cut, *a* is the germ, *b* the style, and *c* the stigma. The germ is at the base of the style or column: it is the seed vessel in which are the *ovules*, or young seeds. The germ is *superior* when above the calyx, as with the strawberry, and *inferior* when below it, as in the apple. Its form is *round*, *cordate* or *angled*. The style is the upright part or stem of the pistil. The stigma is the summit of the style; but, if the style is wanting, it is *sessile* or sits upon the germ, as in the tulip. It is of different forms, is downy and is moistened with a thick fluid to catch the polen from the anther and convey it through the style to the ovary, or germ. The cut shows the central pistil and surrounding stamens.



The *pollen* is a yellow dust, or farina, given out in granules by the bursting of the anther at a particular period. Each particle is an organized body, as may be seen with a glass, when it is placed on the

surface of water: It is *oblong*, *globular*, or *triangular*, *smooth* or with points and is sometimes connected by threads. It is essential for the production of seeds and the propagation of the species. In the East Indies, where palms are cultivated, branches of the wild palm are gathered and the pollen strewed over the cultivated plants.



Pistilate flowers are *fertile*, *staminate* flowers, are *infertile*. The cut shows the pollen thrown out when the anther bursts. Insects fertilize some flowers by the pollen they bear upon their bodies, when in search of honey.

Rains and moist weather are often injurious to plants when flowering, as the pollen is thereby often lost; but most flowers preserve it by holding down their heads in the absence of the sun. The pollen is also conveyed by winds upon pistilate flowers, as may be seen often times in a cloud of dust over forest trees. In every conceivable way nature has provided for the accomplishment of this important purpose, both in the form and situation of the organs and the means of communication. The trees of warm climates generally have stamens and pistils on the same corolla, but in cold climates these are on separate flowers. In some, as in the parnassus, the stamens lean over the stigma successively and shed their pollen on them. Some anthers, as in the laurel, are confined in the corolla till the proper time, when they are suddenly liberated, and by the force of the spring scatter the pollen in a stream over the stigma. The slightest touch at this time will produce the effect.



The calyx, corolla, stamen, pistil, anther, and stigma are seen in this cut.

The use of the sexes, or stamens and pistils, is to perpetuate the species. Without them no seeds are capable of vegetation. They exist in all plants. The process of fecundation we have before explained. The flower is formed before the fruit in all cases. In Monæcious plants the stamens and pistils are on the same plants, but on different flowers, as in indian corn, where the stamens are on the panicle or top and the pistils are within the husk, forming long filaments or *the silk*. Pumpkins, cucumbers, gourds, etc., are of this kind.

Inflorescence. This is the mode of flowering in plants. The corolla in reference to its organs, is important in this subject. We have said that the monopetalous corolla supports the stamens, which in number correspond to the divisions in the limb or top of the corolla. These stamens are inserted on the calyx or receptacle in polypetalous corollas and are double the number of petals, generally, as in the pink. When inserted below the germ, the corolla is *hypogynous*, or inferior to the style, as with the stramonium; when inserted into the calyx, surrounding the germ, as with the currant, it is *perigynous*, or enveloping the style, and when inserted upon the germ, as with the honey-suckle, it is *epygynous*, upon, or superior to the germ.

The position of flowers on the branches or flower-stalks, like that of leaves, is *radical*, arising from the root, or *cauline*, arising from the stem. They are also *sessile, solitary, scattered, opposite, alternate, axiliary*, etc. They grow on one side of the branch and sometimes on all parts of the peduncle, or supporter, causing a great difference in the appearance and position of flowers. This peduncle is the green part, the fruit, or flower-stalk, coming from the stem. Its divisions are *pedicels*. The flower, when it has once blossomed, is commonly inserted in the end of the stem and the peduncle is scarcely distinguishable. An assemblage of flowers around the stem forms a *whorl*, as in mint and labiate plants, in the same manner as leaves in this form are *stellate*, or like a star. When flowers are arranged on a common peduncle, or flower-stalk, as in the locust and currant, they are *raceme*, and *panicle* when borne in an irregular cluster. *Spike* is where flowers, arise from the side of a stem on a short peduncle, as mullein and the grasses. It is erect and the flowers are sometimes crowded around an ear, as in indian corn. When several flower-stalks spread out like an umbrella, as in the carrot and fennel, the form is *umbel*, and when these stalks are irregularly divided, as in the elder and snowball, it is *cyme*. *Corymb* is a false umbel, the peduncles rising from different heights as in the yarrow. Flowers on small stalks variously arranged are a *fascicle*, and when sessile flowers form a *tuft*, like clover, poppy, etc., they are a *head*. Flowers composed of scales, stamens or pistils, etc., as in the willow and chestnut, are *ament*, or catkin. *Spadix* is an assemblage around a common receptacle with a sheath, etc., as with the wild turnip, etc.

The receptacle is the point of the flower-stalk between the peduncle and flower. It first supports the flower and subsequently the fruit. It is scarcely distinguishable in simple flowers, as the tulip, etc. It is *proper*, when supporting 1 flower, as in the lily and violet, and *common* when supporting many flowers, as in the sun-flower and dandelion. These are *convex, concave, flat, spherical*, etc., and its surface is also *punctate, hairy, naked, chaffy, pulpy*, etc. *Rachis* is a receptacle connecting the florets in a spike, as in wheat. In compound flowers, forming chiefly the class *syngenesia*, the receptacle is most important. It is the thread-like part of the *ament* to which are attached the florets, as seen in stripping off the scales of the ament of the willow.

Compound flowers consist of many small flowers each with its stamens and pistils, and all on a common receptacle, as in the daisy, dandelion, sun-flower, etc. The anthers of the flowers are united in a cylinder. They are monopetalous and superior. The central part of the flower is its disk, and the portion surrounding it is its *radius*, or ray.

Aggregate flowers have several florets situated on the same receptacle, and each has its anthers distinct and not united into a cylinder as in compound flowers. The teazel and cats-eye are examples.

BOTANICAL CLASSIFICATION OF PLANTS.

The Linnean system of classification is founded on the stamens and pistils of flowers. All plants are thus divided into 2 great divisions, the *phenogamous*, or those plants having apparent flowers, or sexes, and comprehending the first 23 of the 24 classes of Linnæus, and *cryptogamous*, the 24th class, comprising all plants with non-apparent flowers or sexes. Some include these in the 21st class.

The characteristics of classification used by Linnæus were of 3 kinds: 1st *factitious, made*, or *artificial;* 2d, *essential character;* i. e. a peculiar character of one genus, distinguishing it from all others; and 3d, *natural character*—the general aspect or appearance of plants, by which persons form some classification in their minds independent of rules, etc.

A natural family is composed of several genera having some common marks of resemblance, somewhat like artificial *orders*. Families, truly natural, are such as to enable any one without the aid of science to recognize them, as with the *umbellate family*, composed of dill, fennel, caraway, etc., from the form of the seed-stem and branches, (like an *umbrella*.) Other families are similarly distinguished by the form of the corollas, as *labiate*, (like the *lips*,) *cruciform*, (like a *cross*,) *umbellate*, (like an *umbrella*,) *corymbiferous*, *leguminous*, etc.

The artificial classification is such that genera, *unlike* in general appearance, are classed together by the number of their stamens and pistils, as the tulip and bullrush in order 1, class 8, and the beet and elm in order 2, class 5. Still, this, though more difficult than the *natural* classification, is essential to botanical arrangement, as great numbers of plants cannot otherwise be arranged. It is like a *dictionary*, by turning to which we learn the *character* of plants, their habits and qualities; and the natural method is compared to the *grammar* of botany.

The rules of botanical science are 1st, that botanical classification results from an examination and comparison of plants. 2d, every organic peculiarity in individual plants, establishing a *resemblance* or *difference*, is a *character* or *sign*, by which it may be known and distinguished. 3d, the *presence* of an organ, or its *absence*, is a *character*. 4th, the presence of an organ is a *positive* character, and its absence a *negative* character.

Botany rests on constant characters and these may be *isolated* or *co-existent:* as a "butter cup" has a nectary in the form of a scale, a character, which though constant, is *isolated*, not being necessarily connected with any other characteristic. The calyx of the "blue-bell" adheres

to the germ, which must be without divisions. This adherence induces the inference of several other characteristics, and it is then *co-existent.*

Vegetation and reproduction are two distinguishing orders of characters in vegetable organs. Those plants resembling one another in their character of reproduction differ little in those of vegetation; yet those resembling one another in their characters of vegetation often differ much in those of reproduction. The seed combines the characters both of vegetation and reproduction.

The subdivisions of plants. The 2 great divisions of plants (phenogamous and cryptogamous) are separated into *classes, orders, genera, species,* and *families.* Classes have been compared to *states,* orders to *counties,* genera to *towns,* and species to *families,* and families are composed of *individuals.* Each individual is an organized being, distinct, separate, and complete in all its parts, as an oak, a rose, or a moss. A *species* comprehends individuals agreeing in certain particulars of their stems, leaves, or flowers. These have passed into innumerable *varieties* by different modes of cultivation, by soil, climate, and also by strewing the pollen of one species upon the stigma of another. But these, not producing perfect seeds, are incapable of reproducing themselves. The specific difference is not effected by color, taste, or size.

Species should present the essential characteristics of the family, and of the genus to which it belongs; yet the mark distinguishing it from another species of its genus may be such as does not belong to the whole genus or family. The generic characters are more important than the specific, these being founded on the characters of the organs and isolated; while the former are founded on important apparent co-existent characters; as a pink is more easily distinguished from a rose than one species of rose from another. Families are grouped by marks in the genera to which they belong, and are the most important of all characters. The characters of the classes and orders are artificial or factitious; while in genera, species and families the essential characters are natural characters.

A genus includes one or more species which are grouped together because of some resemblance in the proportion, situation, or connection of the organs of the flower. Each of these species is therefore a type of the other, and is easily referred to its proper genus by a knowledge of any one of them. Some genera are more distinctly marked than others; the rose genus for example. Peculiarities of form or color of the flower, or some remarkable properties of plants also give the generic names. Iris, or flag, is named from its colors resembling the rainbow; *digitalis,* or foxglove, from the resemblance of its corolla to the finger of a glove. The generic names are *nouns,* while specific names are adjectives; yet many of these are derived

also from the names of men, the number and character of leaves, etc.

Family resemblances may be in seeds, pericarps, or seed envelops, stamens, and pistils, corollas, calyxes, mode of flowering, or inflorescence, the situation of the flower, leaves, stem or roots. But it is necessary to observe plants, and the invariable characters of their organs closely to give them their place in species and genera.

The genus *geranium* furnishes an example of the specific characteristics. In several species of this genus, as in other genera, they are named from some plant, the leaves or other parts of which the geranium resembles. Thus there are the *oak-leaved, crow-foot-leaved, acorn-leaved,* etc.; also the *long-stalked, thick-stalked,* etc.; likewise the *rose-scented, fish-scented,* and *musk-scented* geraniums. Places also give rise to the names of species. These then, form convenient and invariable peculiarities, which are incorporated with the name of the species.

Changes produced by *varieties* mostly affect the size, color, and number of petals; forms of the leaves, size, color, and taste of the fruit, and the forms or qualities of the roots, while the seed is unchanged, and produces the original kind and not the variety from which it was taken. The varieties of the apple and pear, though they belong to the same genus, are thus numerous in taste, form, and color, but the species is always the same. Seeds from the same apple tree may produce trees with fruit differing from the parent stock and from one another. Those from green and sour fruit may thus produce sweet, large and red fruit, or otherwise, but they never produce pears, or another species, nor does cultivation or other means ever change the species or genera.

Orders are founded 1st, on the number of pistils, which correspond with the number of the order in each class; 2d, on the seeds being covered or uncovered in the calyx; 3d, on the relative length of the pods; 4th, on a comparison between the disk and ray florets of compound flowers; 5th on the number of stamens; 6th, (cryptogamous) by natural family characteristics.

Stamens and Pistils.





The above cut represents the number of stamens in the first 10 classes, according to the number of the class.

This cut represents the class *Icosandria,* (over 10 stamens *inserted on the calyx.*) It may, however, designate more or less than 20 stamens.



This cut shows the class *Polyandria,* (over 10 stamens *inserted on the receptacle.*)



This cut shows the difference in the length of the 4 stamens, 2 short, and 2 long, and is class *Didynamia.*



This is the class *Tetradynamia,* 6 stamens, 4 long and 2 short.



Class *Monadelphia,* stamens united by their filaments *in one set.*



This is class *Diadelphia,* (stamens with their filaments *united in two sets.*)



This class *Syngenesia,* (5 anthers united in a compound flower.)



The last cut represents class *Gynandria,* stamens growing out of the pistil; the two next, class *Monœcia,* stamens and pistils on *separate* corollas on the *same* plant; and the two first, class *Diœcia,* stamens and pistils in separate corollas on *different* plants.



This cut represents the cryptogamous plants, (stamens and pistils invisible.)

Classes.

The 1st class, *Monandria,* is composed of those plants the flowers of which have *one* stamen. 2d, *Diandria,* those with *two* stamens. 3d, *Triandria,* with *three.* 4th, *Tetrandria,* with *four.* 5th, *Pentandria,* with *five.* 6th, *Hexandria,* with *six.* 7th, *Heptandria,* with *seven.* 8th, *Octandria,* with *eight.* 9th, *Enneandria,* with *nine.* 10th, *Decandria,* with *ten.* 11th, *Icosandria, over ten,* (on the calyx.) 12th, *Polyandria, over ten,* (on the *receptacle.*) 13th, *Didynamia, four,* (2 long and 2 short, flowers *labiate.*) 14th, *Tetradynamia, six,* (four long and 2 short; flowers *labiate.*) 15th, *Monadelphia,* (stamens

united by their filaments into *one* set.) 16th, *Diadelphia,* (stamens united by their filaments into *two* sets; flowers *papillionaceous.*) 17th, *Syngenesia, five* stamens (united by their anthers; flowers *compound*) 18th, *Gynandria,* (stamens growing on the pistils.) 19th, *Monœcia,* (stamens and pistils on different flowers of the same plant.) 20th, *Diœcia,* (stamens and pistils on different flowers of different plants.) 21st, *Cryptogamia,* (stamens and pistils invisible.) Three more classes are added, or some of these last are differently arranged by some writers.

The first 10 *classes* are thus founded on and named from the *number* of the stamens; the 11th and 12th on the *number* and *insertion* of the stamens; the 13th and 14th, on the *number* and relative *length* of the stamens; 15th, 16th, 17th and 18th, on the *connections* of the stamens by filaments or anthers; 19th and 20th, on the *position* of the stamens relative to the pistils; and, 21st, on their being no visible stamens or pistils.

The orders belonging to each *class* with *examples* of flowers, or plants, in which they may be seen, may be briefly stated as follows, omitting the repetition of the *names* of the orders and the number of the pistils, as both are the same in each class, less than 12. The orders of the first 12 classes are according to the number of pistils, and these are named by prefixing Greek numerals to the word *gynia,* which signifies pistil.

The orders in the first 12 classes are founded on the number of pistils, as 1st, *Mono-gynia,* 1 pistil; 2d, *Di-gynia,* 2 pistils; 3d, *Tri-gynia,* 3 pistils; 4th, *Tetra-gynia,* 4; 5th, *Penta-gynia,* 5; 6th, *Hexa-gynia,* 6; 7th, *Hepta-gynia,* 7; 8th, *Octa-gynia,* 8; 9th, *Eenea-gynia,* 9; 10th, *Deca-gynia,* 10; 13th, *Poly-gynia,* over 10 pistils.

1st class, 2 orders; 1st, *Monogynia,* 1 pistil, as ginger, marsh samphire, hippuris, saltwort. 2d, *Digynia,* 2 pistils, as starwort, blitum, etc.

2d class, 3 orders; 1st, (name of the order as 1st above,) as lilac, jasmine, sage, olive. 2d, (same as 2d above,) as spring grass, catalpa. 3d, *Trigynia,* 3 pistils, as pepper.

3d class, 3 orders; 1st, as crocus, iris, or fluor-de-lis, cotton grass; 2d, as wheat, oats, rye, sugar cane and other grasses; 3d, as blinks.

4th class, 4 orders (same number of stamens as in the 14th class;) 1st, as teazel, plantain, dog-wood, innocence, or venus' pride, madder. 2d, as witch-hazel. 3d, as—4th, *Tetragunia,* 4 pistils, as holly, pond-weed, etc.

5th class, 6 orders; 1st, as violet, primrose, currant, tobacco, potato, coffee. 2d, as carrot, beet, hemlock, elm, coriander. 3d, as elder, snow-ball, sumac. 4th, as grass parnassus. 5th, *Pentagynia,* 5 pistils, as flax, sea-lavender. 6th, *Polygynia, many* pistils, as yellow-root, mouse-tail. This *class* comprehends a 10th part of all known plants. Plants with 5 stamens, with those that have anthers united,

constitute a 4th part of the vegetable kingdom. The *umbelliferous family* of plants, as parsnip, celery, parsley; also aromatics, as dill, fennel, caraway, are of the 2d order of this class.

6th class, 5 orders; 1st, as the lily tribe, tulip, crown imperial, hyacynth, pine-apple; the family of palms, onion, bulrush, squill, barberry. 2d, as rice. 3d, as dock, sorrel, meadow-saffron. 4th, (6 pistils,) as—5th, *Polygynia*, (many pistils,) as water plantain.

7th class, 4 orders; 1st, as horse-chestnut, chick-wintergreen. 2d, as limeum. 3d, as—Or. *Heptagynia*, (7 pistils,) as septas. This is the smallest class and without natural families.

8th class, 4 orders; 1st as bilberry, evening primrose, nasturtion, heaths. 2d, as—3d, as buckwheat, water-pepper. 4th, as paris.

9th class, 3 orders; 1st, as sassafras, camphor, cinnamon, cashew-nut of W. I. 2d, as—3d, as flowering rush, rhubarb, etc.

10th class, 5 orders; 1st, as laurel, rue, wild indigo, winter-green, venus's fly-trap, rose tree. 2d, as pink, hydrangia. 3d, as silene, sandwort. 4th, *Pentagynia*, (5 pistils,) as stone crop, corn-cockle, sorrel. 5th, *Decagynia*, (10 pistils,) as Virginia pokeweed.

11th class, 6 orders; 1st, as prickly pear tribe, or *cactus*, plum, cherry, peach. 2d, as agrimony. 3d, as spurge, migniotte. 4th, as —5th, as—6th, *Dodecagynia*, as house-leek. But recent botanists include from one to 6 of these orders under one, called *Di-pentagynia*, signifying from 2 to 5 pistils, and they give an additional order, *Polygynia*, in which are the rose tribe, blackberry, and strawberry. This class furnishes more fine fruits than any other.

12th class, (stamens separate from the calyx and attached to the receptacle, or top of the flower, the number of stamens varying from 20 to several hundreds. The class has few fruits, but many poisonous and active plants. It is said that *no plants with the stamens on the calyx are poisonous*. 5 orders; 1st, as mandrake, side-saddle, white pond lily, tea-tree, poppy, the genus *citrus*, containing the lemon and orange. The 4 succeeding orders are *Di-pentagynia*, from 2 to 5 pistils, as the poisonous Larkspur, monk's-hood, columbine, etc. Or. *Polygynia*, as the peony, clematis, hellebore, magnolia, tulip tree.

13th class, (founded on the number and *relative length* of the stamens and the *orders* on the enclosure of the seeds in the pericarp, or without it, and the comparative length of the pod.) Flowers with 4 stamens, 2 long and 2 short, the outer 2 longest. 2 orders, *Gymnospermia*, (seeds naked, or without a pericarp,) and *angiospermia*, (seeds in a pericarp.) 1st, as the peppermint, lavender, savory, majorum, thyme, penny-royal, catmint, hoarhound, scull cap, blue gentian, (plants with *labiate* corollas.) 2d, (plants with many seeds in a capsule, but none used in food; yet some are medicinal, as fox-glove, cancer-root; some fine flowers as geradia, trumpet-flower, etc.

14th class (*cruciform* plants, with 4 petals and 6 stamens, 4 long

and 2 short; calyx with 4 sepals and corolla of 4 petals, each fastened to the receptacle by a part, with the form of a *cross;* hence the name; one pistil in the centre of the flower, as the cabbage, mustard, radish, gilly-flower. 2 orders, depending on the length of the pod. 1st, *siliculosa,* producing short round pods, as pepper grass, shepherd's purse. The plants here are nutritious and medicinal. 2d, *Siliquosæ,* with long narrow pods, as radish and mustard. The turnip, and wall-flower, are of this order.

15th class, signifying, with the 16th, the *brotherhoods,* the union of the filaments in 1 or 2 sets. The 13 *orders* of this class depend on the number of stamens; 1st, *Triandria,* 3 stamens, with filaments united in one set at the bottom of corolla, and anthers separate, as blue-eyed grass, tiger-flower. 5th, *Pentandria,* as passion-flower, stork-bill, geranium. 7th order, *Heptandria,* including the green-house geraniums, of many beautiful varieties, and mostly natives of the cape of Good Hope. 10th, *Decandria,* containing another genus of geraniums, with 10 stamens. 13th, *Polyandria,* many stamens; the group *columniferæ,* stamens united in form of a column, as the hollyhock, mallow, cotton, tall japan rose.

16th class, 2 (brotherhoods) stamens united by their filaments in 2 sets; flowers *papilionacious,* or butterfly-shaped, (the flower, with 10 separate stamens are in the 10th class.) The orders depend on the number of stamens. Order *Pent-octandria,* (5 and 8 stamens,) as the *corydalis,* fumaria, seneca-snake-root. 10th, Decandria, *leguminous* plants, as the bean and pea tribe, rattlebox, clover, locust tribe, indigo, sandal wood, liquorice, sensitive plant, gum arabic, tamarind, furze. Some give 8 orders in this class.

17th class, (a union of anthers,) mostly 5 stamens. Some are retained in the 5th class, but are distinguished from that by the *union of anthers* and *compound flowers,* which are distinguished as *semi-flosculous,* (having ligulate florets,) *flosculous,* (having tubular florets,) and as *radiated* with tubular florets in the centre and ligulate at the circumference. These florets are called *rays.* Plants of the 1st character have a bitter narcotic milky juice, as lettuce, dandelions; the 2d are bitter in leaves and roots, as burdock; and the 3d *corymniferous,* as crysanthemum, aster, etc. Tansey and boneset are of this division. The daisy, sunflower, etc., are of the order. This class, depending on the situation of the florets, these are 1st, *perfect,* when with stamens and pistils; 2d, *barren,* with stamens only; 3d, *fertile,* with pistils only; and 4th, *neutral,* without stamens or pistils.

5 orders in this class, 1st, *Equalis, compound* florets, all perfect, distinguished by florets *ligulate, tubulous,* (in a head, as dandelion,) or tubulous without *rays,* as boneset, thoroughwort. 2d, *Superflua,* the pistils of the ray being without stamens and therefore superfluous. There are 2 sections of the order, 1st, without rays, as life everlasting,

tansey. 2d, those with rays, as the aster genus, golden-rod. 3d, order *Frustranea*, disk florets perfect, as coreopsis, helianthus, blessed thistle. 4th order, *Necessaria*, rays fertile, disk florets barren, as the marygold. 5th, *Segregata*.

18th class, (from the situation of the stamens on the pistil.) 1st, with one stamen, as the orchis tribe of plants. 2d, as ladies' slipper. 5th, as the milk-weed. 6th, as snake-root. 10th, as wild ginger.

19th class, (*imperfect* flowers, determined by the number of stamens or pistils only. 1st, as bread-fruit in the natural order of fig, mulberry, etc. 3d, as cat-tail, sedge, indian corn. 4th, as white mulberry. 5th, as genus amaranthus. Order *Polyandria*, as many of the most beautiful forest trees, hazelnut, oak, beach, walnut, chestnut, birch, Egyptian lily. 15th, *Monodelphia*, as cucumber, squash, watermelon, pumpkin, pine, cypress.

20th class, *imperfect* flowers, stamens or pistils only; orders from the number of stamens. 2d, as the willow. 5th, as hemp, hop, etc. 6th, green-briar, honey-locust. 8th, as poplar. 15th, as red-cedar, yew, etc.

21st class, *cryptogamous* plants, stamens and pistils concealed and all plants not in the above classes. 1st, as ferns. 2d, as mosses. 3d, as liverworts. 4th, as sea-weeds, fucus, etc. 5th, as lichens. 6th, mushrooms.

The 2 orders of the 14th class are known by the *form of the fruit*; i. e., 1st, *Silicula*, fruit a roundish pod and 2d *Siliqua*, fruit a long pod. The orders of the 15th and 16th classes are known by the number of stamens. The 5 orders of the 17th class are distinguished by circumstances of the flowers; i. e. 1st, *equalis*, (stamens and pistils *equal*; 1 stamen, 1 pistil, and 1 seed, hence *perfect*,) 2d, *superflua*; i. e. florets of the disk perfect and of the ray with *pistils only*, which being without stamens are superfluous. 3d, *frustranea*, florets of the disk perfect, and of the ray *neutral*, which being without stamen or pistil, are useless or *frustrated*; 4th, *necessaria*, florets of the disk, *staminate* and of the ray *pistilate*, which is necessary to perfect the fruit. 5th, *Segregata*, partial calyxes or florets with a *perianth*, or one envelop. Orders of classes 18, 19, and 20, depend on the number of pistils as with the 15th and 16th; and the orders of the 21st, cryptogamous, class are *felicles*, as ferns; *musci*, as mosses; *hepaticæ*, succulent mosses; *algea*, as sea-weeds; *lichens*, growing on old trees; and *fungi*, as mould and mushrooms.

Genera. The class and order of a plant in the Linnean system having been found, the *genus* is the next object of inquiry. In a genus having but one species, the generic description is confined to that species; but when it includes many species the description is based on the parts of the species agreeing with one another. Generic descriptions are founded on the flower or sexes and are so brief that a genus

is completely described and distinguished in a few words. Large genera are separated into families consisting of species having a general agreement in some peculiarities among themselves. The *names* only of a part of the classes and orders are mentioned in describing plants, they being understood by the number of stamens and pistils; for example, the class *Monandria*, has 1 stamen, and the order Monogynia, 1 pistil, etc.

The genus Viola, (violet,) thus comes under class 5, *Pentandria*, and order 1, Monogynia. Its divisions under this class and order are, *flower polypetalous, inferior, seeds in a capsule;* and its generic description expressing the essential characters of the genus, is, *sepals* 5, *petals* 5, *irregular, connate behind, anthers adhering by a membrane at the end, or distinct, capsules* 3 *valved*, 1 *seeded*. The class signifies the number of stamens from *pente*, 5, and *aner*, a stamen, (pentandria,) and the order also signifies one pistil. The division likewise shows that the flower being "polypetalous" means that it is composed of many petals, and "inferior" means that the corolla is situated below the germ. "Seeds in a capsule," signifies that the seeds are within a pericarp which becomes dry and opens by valves. The corolla is "irregular" because the petals are of unequal size, and one of them ends in an appendage behind. "Connate" means joined; i. e. the petals are apparently connected. *Sepals* are the leaves of the calyx, and *petals* are the divisions of the corolla. This genus (Viola) includes a great number of species, all agreeing in these essential characters; but they differ from one another by the forms of their leaves, or other circumstances, as the *sweet-violet*, from its pleasant odor, or *toothed-violet*, from its leaves being dentated or toothed on their margin.

The specific description applies only to those parts of a plant which simply distinguish one individual of the same genus from another and is defined botanically in a few words, as with the *viola pedata*, "stemless, leaves pedate, 7 parted." Thus the pistils, stamens, calyx, corolla, fruit, flower, signifying the place of the plant in the system, have nothing to do with the specific description.

The natural method of classification by Jussieu, and others depends 1st, on the *structure of the seed with respect to cotyledons:* thus a plant with no cotyledon is *A-cotyledonous;* with 1 cotyledon it is *Mono-cotyledonous*, and with 2, *Di-cotyledonous*.

2d. *The insertion of the stamens.* These are *above* the germ and epi-gynous, *under* it and hypo-gynous, or *around* it and peri-gynous.

3d. *The presence or absence of the corolla.* Thus, when wanting the corolla, plants are *a-petalous.* The corolla being of one piece, or without petals, it is *mono-petalous*, and when the corolla has many petals it is *poly-petalous*.

4th. *A union or separation of anthers*, i. e. anthers *distinct*, or *combined*.

By this system all vegetables are divided into two great classes, founded on their structure; viz., *Vasculares* and *Cellulares*. The 1st includes the phenogamous, or flowering plants, and the 2d, the cryptogamous, or flowerless plants. All the 1st are propogated by seeds composed of 1 or more cotyledons and hence are called *cotyledonous*, while the 2d are supposed to have no seeds, properly speaking, or cotyledons.

The vasculares possess spiral vessels and a woody fibre, with reticulated leaves. The cellulares are distinguished by their cellular structure, having no vascular system, like the first. These classes are characterized further by their structure and growth, as noticed at page 67.

The cryptogamous, or "flowerless" plants of the Linnean system are included in the *A-cotyledonous* of Jussieu. The *monocotyledons* consist principally of palms, grasses etc., and are *endogenous*. This division consists of 2 large groups: 1st, of plants, the flowers of which have petals, *petalloidæ*, as the lily and iris, the calyx and corolla being in 3 or 6 divisions; 2d, where the stamens and pistils are surrounded with *bracts*, *glumaceæ*, as in the grasses.

The dicotyledons include all the phenogamous plants, or first 23 classes of Linnæus, except the monocotyledons. Those are vascular in their structure or *exogenous* in their growth.

The 1st lesson in this system is to examine the seed-lobes, and then to answer the questions—

Has the seed any lobes? If none, it belongs to Div. 1; if it has, then how many has it? If *one*, then it belongs to Div. 2; and if 2, or more, then it belongs to Div. 3.

If the seed cannot be found, then the stem or the leaves must answer the following: Are there any sap and pulp vessels? If not, then the plant belongs to Div. 1; if there are, then is the stem tapering upward, covered with bark and the wood softer on the exterior than the interior? if not, then it belongs to Div. 1; but if it is, then it belongs to Div. 3.

This is simply a notice of Jussieu's method, and there is another of Tournefort's. The 1st depends on the *cotyledons*, and the 2d on the aspect and other circumstances of the *corollæ*, while the Linnean system is based on the *stamens* and *pistils*. The 1st is thought by some too indefinite; the 2d is not and cannot be relied on, and the 3d is, and has been from the first, the system generally adopted. Jussieu's method, however, is in part, if not entirely, adopted by many distinguished botanists.

A few directions may be suggested to those who, from the brief botanical sketch we have given of the *artificial system*, may desire to make some examinations of flowers.

An herbarium may be made of a quarto book of white paper in

which flowers or leaves are secured, after being pressed in some old book or soft paper to absorb the moisture. At the side of the specimen may be written the class, order, genera, species, and any remarks as to locality, time, etc. If brushed over with corrosive sublimate, worms will not affect them. Nothing can be more pleasing than excursions for the collection of specimens. A magnifying glass will add much to the interest of observations.

Classes. If the stamens and pistils are not visible, then the plant belongs to the *division cryptogamia.* If visible it belongs to the *division phenogamous,* including 20 of the 21 classes. If both stamens and pistils are on different flowers, it then belongs to the *class Diœcia* or *Monœcia,* according as they proceed from the same or different roots. If both are on the same flower and the *anthers* are united around the pistil, the plant belongs to the class *syngenesia;* but if the anthers are separate and the *filaments* are united to the pistil, it belongs to the class *Gynandria;* but if the filaments are not united to the pistil and are united with each other, and are in *two* sets, it belongs to the class *Diadelphia,* and if in *one* set, to the class *Monadelphia.* If the filaments are separate, and of different *lengths,* (only where there are 4 or 6 stamens,) and the flower has, say 6 stamens, 2 short and 4 long, it is of the class *Tetradynamia;* if 4 stamens, 2 short and 2 long, it is of the class *Didynamia.* If the flower has no one of the above peculiarities and the stamens are more than ten, then their *insertion* is to be considered. If inserted on the receptacle, the flower is in the class *Polyandria;* but if inserted on the calyx or corolla, then it is in the class *Icosandria.* Should the flower have less than 20 stamens, without any of the before mentioned distinctions, as to connection, position or length, then the number of stamens, if less than 11, determines the class, and so with all the other 9 in the order of the class. This is the analytical mode of determining the place of plants; but when they are placed together to form a species, and several of these to form genera, these to form orders, and these to form classes, the process is synthetical.

For analysis simple and natural flowers should be taken, as double ones often change their stamens and sometimes their petals by cultivation. Let, for example the pink be taken. This will be seen to have 10 stamens, and therefore of the *class* Decandria; and, as the 1st 12 *orders* depend on the number of pistils it will be seen that this having 2, belongs to the 2d order, *Digynia.* The flower must now be compared with the different genera until its generic character be found. Thus, for example, take the genus *hydrangea* which is calyx 5 *toothed, superior,* etc. The calyx of the pink has 5 notches or teeth around it, but is not *superior.* Then take *Saxafraga*; *calyx* 5 *parted, half superior,* but the pink not being half superior, take the genus *Saponaria, calyx inferior, leaved, tubular,* 5 *toothed,* and *calyx without scales.*

The pink therefore agrees with this, except that it has *scales*. Take then the *Dianthus*; *calyx inferior, cylindrical,* 1 *leafed, with* 4 *or* 8 *scales at the base; petals* 5, *with claws, capsule cylindrical, celled, dehiscent,* or gaping. This agrees with the pink throughout, and it is therefore of the genera or family *Dianthus*. Now, as to the species, take a description of the species of plants and go on in like manner by comparison of flowers and leaves, when it will be found *caryophyllus,* which is *flowers solitary, scales of the calyx sub-rhomboid, very short, petals crenate, beardless.* And thus the botanical description is complete. For these and other terms turn to the glossary.

The rose, lily, poppy, etc. may be analyzed in a similar manner.

The Natural System.

We here give a synopsis of this method of classification, and the principles on which it is founded. It has been said that by this arrangement plants are divided into two great classes based on their structure and called *vasculares* and *cellulares*. The *artificial system* arranges plants in conformity with the number, appearance, or situation of some particular organs or parts. The *natural method* distributes them according to their natural affinities, or qualities. Many discrepancies exist in the natural affinities of plants as classed and grouped together by the artificial, or Linnean system; and there are likewise some in the natural system; but it is thought that the natural points of resemblance, affinity or relation in both forms and qualities add greatly to the interest of the study of plants; though in this arrangement plants are necessarily divided into a very large number of families, or orders.

The 1st class, *vasculares,* includes all the *flowering,* or phenogamous plants, and the 2d class, *cellulares,* includes all the *flowerless* or cryptogamous plants. These two divisions are also characterized by the different modes in which they are propagated. They are, as we have before noticed, distinguished by the number of the lobes or cotyledons of the seed. All flowering plants being thus propagated by seeds are called *cotyledonous,* or vasculares, while the flowerless plants are without cotyledonous seeds, stamens, or pistils, hence are called *acotyledonous* or *cellulares*. Plants of the 1st class have, of course internal spiral vessels, or a vascular system, with more or less woody fibre and with their leaves reticulated, or in parallel veins. Those of the 2d class are formed, of course, entirely of cellular tissue, containing no spiral vessels nor woody fibre, and their leaves are not traversed by veins, as are those of the other class. Thus these two divisions, though very unequal in the number of plants they embrace, are founded on their anatomical structure as well as external characters.

The class Vasculares is separated into two sub-classes, on account

of their two different modes of growth. The first of these divisions is called, as we have before noticed in speaking of stems, *exogenous*, or outside growers, as the oak, for example; indeed all trees of the U. S. and of all northern latitudes, except the palms of the south. The 2d division of this class is composed of *endogenous* plants, or inside growers, as the palm, lily, and iris; they, having no need of bark or external covering, as they grow internally. Their substance or structure is confused, while that of exogenous plants is distinct and in regular annual deposites from the pith or centre outward, as will be seen by examining any of our trees or their branches, when divided crosswise. These last have seeds with 2 lobes, are propagated by such, and hence are all called *dicotyledonous*, while the former, or endogenous plants, have single-lobed seeds and are *monocotyledonous*.

Again the exogenous plants are divided into two tribes called *angiospermiæ*, and *gymnospermiæ*, the first denoting that the seeds are enclosed in a pericarp, and the 2d, that they are naked, or destitute of a pericarp. The endogenous are also divided into two tribes, the first being called *Petaloidæ*, including all plants of the class (all, in fine, with 1 cotyledon, except grasses, and sedges) which have a calyx and corolla in 3 or 6 dvisions; or if these are absent, then the stamens and pistils are naked. The 2d tribe is called *glumaceæ*; such plants of the class as have flowers with no true calyx nor corolla, but which are enveloped in imbricated bracta, as all the grasses and sedge tribe. There are also 3 sections in this class called *Filicoidæ*, *Muscoideæ*, and *Aphyllæ*. The 1st are such plants as have a distinct axis and vascular system, as ferns, club-mosses, and horse-tail; 2d such as have a distinct axis, but not a vascular system, as musci, (mosses,) and hepaticæ, (liverworts,) and the 3d have no distinct axis nor vascular system, as the fungi (mushrooms) Algæ (flags.)

Sub-class 1. *Exogenous or dicotyledonous plants.* Tribe *Angiospermæ*, 2 seed-lobes inclosed in a pod, shell or coat, as pea, chestnut, etc. The flowers of this tribe are *polypetalous*, (many petalled,) with calyx and corolla, as crow-foot; *apetalous*, (without petals,) with calyx, but no corolla; *achlamydeous*, (no calyx, or corolla,) as birch, willow, etc; *monopetalous*, with a single petal, as trumpet-flower, morning-glory.

Tribe 2, *Gymnospermæ*, seeds without a pericarp, and plants without a stigma or pistil. The tribe is divided into *Conniferæ*, (fir tribe,) as pines, juniper, etc., and *Cycadeæ*, as cycas, zamia, etc.

Sub-class 2, *endogenous* or *monocotyledonous* plants. Plants of this class are intermediate between those of the 1st, which are of the highest order of development, and the cryptogamous plants which are of the lowest. Their character is indicated by their leaf when held up to the light, these leaves being traversed with veins, showing that its seeds are dicotyledonous, as plum, apple, radish, etc.; the leaves are also articulated or jointed with the stem. If veins of another leaf,

held to the light, be found running parallel with each other, unlike net-work and unarticulated with the stem, then it is also known that the plant sprung from a single cotyledon, as lily, indian corn, wheat, the grasses, etc. These are remarkable evidences of harmony in nature.

There are 272 orders in this system. One example may illustrate the others.

Amygdaleæ, the almond tribe, (including the peach.) The *diagnosis* is, polypetalous, cotyledons with a superior, solitary, simple ovarium, having a terminal style; regular perigynous indefinite stamen; a drupaceous fruit; an exalbuminous suspended seed and alternate stipulate, simple leaves, yielding hydrocynic (prussic) acid. *Essential characters* (description of the several parts.) *Affinities;* distinguished from the rose and apple tribes by their fruit being a drupe, the bark yielding gum and the presence of prussic acid in the leaves and kernels, also from the pea tribe by the last characteristic, by their regular petals and stamens and the odd segment of the 5 lobed calyx being inferior, not superior, etc. *Geography*, (natives of northern hemisphere,) *Properties*, (description of the various qualities.)

To find by the definition of the class, sub-class and tribe where the class *Amygdaleæ* belongs, the *peach* may be taken as the representative of all the other species of the order. The peach, then, is characterized by its pith, woody fibre, spiral vessels and bark and distinct flowers furnished with stamens and pistils, showing that it is of class 1, *Vasculares*, or flowering plants. The leaves also having veins distinctly reticulated and articulated with the stem, and the seed having 2 cotyledons, placed opposite each other, show that it belongs to the sub-class 1, *exogenous* or *dicotyledonous plants*. The seed is inclosed in a pericarp, called a *peach-stone*, it therefore falls under tribe 1, *Angiospermæ*. The flowers also being many-petaled brings it under division *Polypetalous*.

Essential characters of the peach, calyx 5 toothed, deciduous; petals 5, perigynous; stamens 20 or more, arising from the throat of the calyx; ovary superior, etc. All the species and varieties of the order *Amygdaleæ*, coincide in the description and qualities noticed, and therefore form one natural order and tribe. Other examples may be taken in the same manner. But we are compelled to be brief; and we have therefore simply noticed some general distinctions in order to lead to further examinations of the natural system of classification.

Natural Orders.

This is the arrangement of orders by Jussieu, as before said, and is that adopted at the *Jardin des Plants*, Paris, and by eminent botanists. We propose only to take from this arrangement the useful properties

and distinct characters of the plants under the several classes. Thus far it is important to every reader.

Class 1. *Acotyledons,* (embryo destitute of cotyledons.) *Fungi,* (mushroom-like plants;) substance fleshy, fungous, or mucilaginous, round or flat, no leaves, flowers, anthers nor pistils; known as toad-stools, puff-balls, etc.; *tonic* when dry, *narcotic* when juicy; some eatable, others poisonous. *Musci,* (moss-like plants;) herbaceous; grow in wet places, in northern latitudes; resemble *herpaticæ. Algæ,* (sea-weed-like plants;) aquatic, herbaceous, grow in salt and fresh water; ex. *rock-weed, fucus, confervæ. Lichens,* rarely vegetate on the earth, parasitical, grow in dry places, some used in dyeing and some for food. *Filices,* (fern-like plants;) fibrous roots; ex. common fern, scouring rush. *Hepaticæ,* (liverwort plants;) succulent; some grow in water, some in earth and some are parasites; resemble mosses. *Naiades,* (duck-meat tribe;) floating plants, cellular stems, leaves scarcely seen; *astringent.*

Class 2. *Monocotyledons,* (stamens hypogynous, embryo with 1 cotyledon.) *Androideæ,* (arum tribe,) acrid and heating; ex. wild-turnip, calla. *Typhæ,* (cat-tail tribe;) grow in marshes or ditches. *Cyperoideæ,* (sedge-grass tribe;) herbaceous, leaves grass-like, flowers glume-like, roots fibrous. *Gramineæ,* (the grasses;) important family; farinaceous, valuable as food for man and animals; ex. wheat, meadow-grass, sugar-cane, etc.

Class 3. *Monocotyledons,* (stamens perigynous; fruits with 3 cells.) *Palmæ,* (palm tribe;) of warm climates. *Liliaceæ,* (lily-like plants;) ex. tulip, lily. *Asparagi,* (asparagus-like plants;) fruit a berry. *Narcissi,* roots bulbous. *Irideæ,* (iris-like plants,) roots tuberous. *Junceæ,* (rush tribe.) *Bromliæ,* (pine-apple tribe.) *Asphodeli,* (asphodel tribe; acrid and stimulating. *Commelineæ,* (spider-wort tribe.) *Alismaceæ,* (arrow-head tribe.) *Colchiceæ,* (cholcicum tribe,) emetic and cathartic.

Class 4. *Monocotyledons,* (stamens epigynous.) *Orchideæ,* (orchis-like plants,) farinaceous and emolient. *Musæ,* (banana tribe;) ex. plantain and bread-fruit. *Cannea,* (indian-reed tribe;) aromatic and carminative. *Hydrocharides,* (tape-grass tribe; floating plants.

Class 5. *Dicotyledons,* (apetalous, stamens epigynous.) *Aristolochiæ,* (wild-ginger tribe,) perennial.

Class 6. *Dicotyledons,* (stamens perigynous; monosepalous.) *Elæagneæ;* ex. pepper-grass. *Hymeleæ,* under shrubs; ex. leather-wood; bark caustic. *Proteæ,* (silver-tree tribe.) *Lauri,* (laurel tribe;) trees; fruit a berry or drupe; ex. spice bush and sassafras; various and important medicines. *Polygoneæ,* (dock tribe;) herbaceous; fruit a nut; seed farinaceous; ex. buckwheat, dock, rhubarb. *Atriplices,* (pig-weed tribe;) ex. beet, poke, and pig-weed.

Class 7. *Dicotyledons,* (stamens beneath the germ.) *Amaranthi,*

(coxcomb-like tribe,) herbaceous. *Plantagineæ*, (plantain tribe;) herbaceous; useful pot herb. *Nyctagines*, cathartic and emetic. *Plumbagines*, (marsh-rosemary tribe.)

Class 8. *Dicotyledons*, (corollas monopetalous, hypogynous, etc.) *Lycimachiæ*, (primrose tribe.) *Pediculares*. *Acanthi*. *Jasminiæ*, (lilac tribe.) *Vitices*, (verbena tribe;) stimulating. *Labiatæ*, (mint-like plants;) large family; seasoning food; ex. sage, summer-savory, thyme; medicinal, as horehound, catnip, etc. *Scrophulareæ*, narcotic. *Solaneæ*, (potato-like plants;) ex. tomato, red pepper; narcotic and stimulating. *Borragineæ*, (borage-like plants;) emolient. *Convolvuli*, (convolvulus tribe;) ex. sweet potato; some medicinal. *Polemoniæ*, (phlox-like plants;) herbs. *Bignoniæ*, (trumpet-flower tribe.) *Gentianæ*, (gentian tribe;) herbs, some medicinal; ex. columbo-root; cathartic. *Sapotæ*, W. I. plum. *Apocyneæ*, (dog-bane tribe;) ex. milk-weed.

Class 9. *Dicotyledons*, (corolla monopetalous; perigynous.) *Ebonaceæ*, (ebony tribe.) *Klenaceæ*, (persimon tribe;) foreign. *Rhododendreæ*, (rose-bay tribe.) *Ericeæ*, (heath-like plants.) *Guaiacaneæ*, (lignum vitæ,) gum guaiacum. *Campanulaceæ*, (bell-flower tribe;) ex. lobelia, indian tobacco, powerful medicine.

Class 10. *Dicotyledons*, (corollas monopetalous; epigynous.) *Cichoraceæ*; ex. dandelion, lettuce; anti-scorbutic and anodyne. *Cinarocephalæ*; ex. thistle, burdock. *Corymbiferæ*, (thoroughwort plants;) valuable for medicines; some reckon thistle tribe, aster tribe, colt's-foot tribe, sun-flower tribe, etc.

Class 11. *Dicotyledons*, (corolla monopetalous; epigynous.) *Araleæ*, (ginseng tribe.) *Umbelifereæ*, (parsley-like plants,) herbaceous; ex. dill, fennel, caraway; medicinal qualities various.

Class 13. *Dicotyledons*, (corolla polypetalous; stamens hypogynous.) *Ranunculaceæ*; large order some astringent, as gold-thread; some good dyes, etc. *Papaveraceæ*, (poppy-like plants;) herbaceous; ex. blood-root; narcotic and anodyne. *Cruciferæ*, plants with cruciform corollas, chiefly garden vegetables. *Capparides*, (cruciform plants.) *Sapindi*; ex. soap-berry. *Acera*, (maple tribe.) *Malpighiæ*. *Hypericæ*, (St. John's-wort tribe;) resinous juice; some healing to wounds. *Gutifereæ*; ex. gambogia. *Aurantia*, (orange tribe;) ex. lemon; refrigerating tonic. *Meliæ*, astringent, anodyne. *Vites*, (vine family.) *Geraniæ*, (geranium tribe.) *Malvaceæ*, (holly-hock tribe.) *Magnoliæ*, (tulip-tree tribe.) *Annonæ*, ex. custard-apple. *Menispermeæ*, moonseed. *Berberides*, ex. witch-hazel, barberry. *Tiliaceæ*, (bass-wood plants;) ex. tilia, lime-tree. *Cisti*, red rose plants; ex. cistus. *Rutaceæ*, (rue plants.) *Caryophilleæ*, (pink-like plants;) herbaceous.

Class 14. *Dicotyledons*, (corolla polypetalous; stamens epigynous.) *Sempervivæ*, (house-leek plants,) emolient. *Saxafrageæ*, (saxafrage

plants.) *Cacti*, (prickly-pear tribe.) *Portulaceæ*, (purse-lanet tribe,) emolient. *Ficoideæ*; ex. ice-plant. *Onagræ*; (willow-herb plants.) *Myoti*; ex. mystus. *Melastomæ*. *Salicariæ*. *Rosaceæ*; (rose and apple tribe.) *Leguminosæ*, (pea tribe;) fruit legume. *Terebintaceæ*; ex. sumach. *Rhamni*; ex. buckthorn.

CLASS 15. *Dicotyledons*, (stamens and pistils declinous, or on different flowers.) *Euphorbiæ*; ex. spurge. *Cucurbitaceæ*, (melon-like plants;) ex. water-melon, cucumber. *Urticeæ*; ex. hop. *Amentaceæ*; ex. oak, willow. *Coniferæ*, cone-bearing trees; ex. pine, cedar.

VEGETABLE GEOGRAPHY.

Vegetables, considered with reference to their *habitation* and their particular locality or *station*, is a science of much importance to the general reader and observer, the natural philosopher and horticulturist, and, in truth, to whole nations of people. Nothing can more enlarge and exalt the mind or prove of more practical importance in the selection and cultivation of the most valuable vegetable products in other places and countries than those in which they are commonly found. Forest trees, fruits, grasses, grains, etc., have thus been widely diffused and rendered productive for the best interests of man. *The productive strength of a country is justly estimated by its vegetable resources.* It is from this, more than from any other consideration of a general character, that our own country is distinguished. A glance at *American vegetable geography* in the following pages will be a convincing evidence of this fact. Linnæus was the first who, besides his systematic arrangement of plants, gave their *stations* or *habitations*; and he has been followed by many learned and all systematic writers on vegetable nature, especially by Humboldt, Schouw, and Candolle. "*The laws observed in the distribution of vegetable forms*," by the first, is eminently valuble. But we propose by the following remarks a broad survey only of the regions of vegetation, and a glance at the natural agents which influence the situation, life and development of plants.

Particular plants, it must be obvious to the reader, are limited to particular districts, or parts of the earth. The causes of this are likewise known to be chiefly soil and climate. The two extremes of climate are plainly the tropics and the polar circles. One is exhibited in the most luxuriant and magnificent dress of vegetation within a never-ending summer, while the other exhibits a feeble, diminutive, and scattered vegetation, with little freedom from withering cold and

blasting frost and snow. Between these extremes, it is apparent, vegetation assumes an intermediate character, varying as the zone approaches one or the other of the extremities. Both the temperate and torrid zones are likewise little less distinctly divided by mountains. At the base of these may be seen healthy and luxuriant vegetation, while upon their summits it is characterised by that of the polar regions. This, however, corresponds with the altitude of the mountains. Some even in the torrid zone, present the climate of that of the arctic regions, while others of a less elevation maintain a vigorous vegetation.

Local vegetation depends again upon the peculiar constitution of plants. Some plants are so hardy and vigorous as to sustain the extremes of climate, growing with little difference of vigor and productiveness in both cold and and warm climates. This is most providentially remarkable with many of the most nutritive plants. It has been said, in regard to climate upon vegetation, that the earth is comparable to two high and immense mountains with their bases united, like the halves of an orange in the centre, the circumference of which constitutes the equatorial region, and the summits the arctic regions. It is remarkable, however, that almost every country has a vegetation peculiarly its own, distinguished by the peculiarities of its natural boundaries and the general character of its surface. Thus it will be seen that Europe presents a very different class of vegetables from the same latitudes in America. Parallels of latitude corresponding with those of Africa also exhibit in America very little resemblance. Even the small island of G. Britain is distinguished by a remarkable difference in plants on its eastern and western sides, and like differences are observable on islands of corresponding latitudes. Medicinal plants and drugs are particularly distinguished, in vegetable geography, by location.

Outlines of American Vegetation.

A glance at the forest region of North America presents an eastern and western division, with an intermediate range of underwood. There are 332 genera of plants which are considered peculiar to N. America. Prior to the introduction of civilization, the whole eastern portion of this country, from Hudson's Bay to the Gulph of Mexico, was an unbroken forest extending back to beyond the Mississippi, and presenting the most extensive forest on the globe. It comprised about 140 kinds of trees, more than half of which rise to over 60 feet in height. Among those that distinguished it were the *Am. cyprus*, the *hickories*, the *tulip tree*, the *locust*, numerous and magnificent *pines*, *oaks*, *ashes*, the *coffee tree*, *magnolia*, *sycamore*, *loblolly-bay*, and innumerable others of remarkable kinds.

Vegetation is here divided into three districts; the 1st, or *northern*,

extending south to lattitude 44°; the 2d or *middle*, from thence south to 35°, being sub-divided east and west by the Alleganies; and the 3d or *southern*, from 35° to 27°, after which vegetation is blended with that of the tropics, especially on the Atlantic coast.

The species begin far up in the northern division and run south to the *red* and *white pines*, the *Am. Larch*, etc., soon after which are found the *canae*, the *yellow* and *black birch*, the *true sugar* and the *red maple*, the *red beech*, the *Am. elm*, etc. The *underwood* of this division consists of numerous important shrubs and small trees, while the *herbaceous* and smaller plants comprise many species common to Siberia and northern parts of Europe. Every native species of the last on both continents, as an invariable rule, extends to near the *Arctic Circle*, where trees and large shrubs cease, and vegetation every where within is the same. The *aquatic plants* have little peculiarity, the more showy of the southern kinds extending far into the northern division. In the desolate region of the extreme north, few vegetable species are able to exist. On *Melville island*, lat. 74° 30′ N., the most northern part to which vegetation has been traced, it consists of the humble *grasses*, *mosses* and *lichens*. No tree appears and nothing of a woody structure, save the solitary *willow*, 6 inches in height. The *red snow plant*, here exists and penetrates still more northern latitudes, multiplying amidst eternal snow and staining it with its crimson color.

The middle district introduces us to the Flora of the U. S. This is characterized by numerous *oaks*, *ashes*, *hickories*, *walnuts*, *red birch*, *white cedar*, *red juniper*, *pines*, *maples*, etc. And the *underwood* consists of innumerable varieties common in the northern, middle, and eastern states. Within this district the *herbaceous* plants are very numerous and many are of signal importance. Fine flowering *aquatics* are also numerous in this division, with many important *grasses* of peculiar forms. This district, as was observed, is sub-divided by the Alleganies which mark a distinctive soil between the east and west, and characterizes the nature of the plants. These peculiarities are numerous, but are perhaps so well understood as to render a notice of them unnecessary. The Alleganies themselves possess many remarkable species of plants and others common to the northern division.

The southern division, on proceeding from the middle district, presents an increasing variety of species and genera. While this contains many plants common to the middle and even northern districts, it is signalized by the tropical kinds. The evidences of an approach to a tropical climate are first perceived in the *cotton* and *rice* fields. The increased heat and humidity are strongly marked, and the vegetation is more mixed, than in corresponding latitudes of other parts of the earth. With the cotton and rice we find also the *indigo* and the *sugar-cane*. The cyprus of gigantic dimensions and dense masses of *long moss*, etc., are indicative of the mixed productions. This southern

district passes almost insensibly into the tropical vegetation of Mexico.

The eastern parts, however, possess distinguishing features from the western. The *nutmeg* and *hickory* mark the west, while the tall *palmetto* and *long-leafed pine*, do the same with the east; still there are few tropical plants that might not be cultivated in the genial clime of Florida. *Climbing plants* have also become much more numerous, often rendering the forests impenetrable, while others impart an aspect peculiarly tropical to our American vegetation. Many of the *herbaceous* plants of this district are also remarkable and important. The *aquatics* are very abundant and peculiar, among which is the *cane*, a gigantic grass so important in its production of *sugar*.

The prairie regions of the west present a wide difference in the character of vegetation from that we have considered. Here the *grasses* have taken the place of forest trees and shrubs; and in the northern parts is presented a gay profusion of flowers. The southwest, however, is almost barren of vegetation, and towards the *Rocky mountains* it is literally a desert. A few *spruces* in the north, *pines*, *maples*, *oaks*, and *poplars* in the middle, and *pines* in the south are the only trees to relieve this vast western plain. These wastes are far beyond the Mississippi; reaching quite to the Rocky mountains, and from near the Mexican gulph to lat. 54° N. and botanically divisible into two sections by the 35th parallel of latitude. Their vegetation, in many respects is peculiar; but it would be impossible to describe the diversified features of this wide, wild and romantic region.

Crossing the Rocky mountains we meet with a range of forest extending along their base 100 miles from the Pacific, for several hundred miles in extent, abounding with some of the most magnificent forest trees in the world, especially the gigantic pines before mentioned. This is, indeed a new botanical region, distinguished alike in its characteristic trees, shrubs and herbaceous plants; and it opens a vast field for scientific investigation. The northern shores of the Pacific present the same vegetation as those of the northern Atlantic, and very many trees and shrubs reach the opposite shores of Asia.

American Forest Trees.

It is only after arriving within the U. S., from the north, that the most beautiful and valuable of nutritive plants and the more useful and magnificent of forest trees present themselves to view. At this point, too, appear successfully the *cereal grains*, so important to man. The North American Flora here, indeed, presents her characteristic features, and trees and products the most valuable abound. Here are the *white oaks* of the northern and middle states, with a height of 70 and a diameter of 6 feet. The *live-oak*, the most durable of trees, so valuable for ship building, abounds in E. Florida. The *scarlet oak* is common in

the middle and southern states, rising to 80 feet in height; the *red oak* of the more northern states, the *black* or *yellow-oak*, one of the most lofty of our forest trees, rising to the height of 90 feet, common to most of our states and affording the valuable *quicitron dye*; the *swamp oak*, the *pin oak*, and the *post oak*, extensively diffused through the country; the *black-jack*, the *water oak* the *laurel oak*, etc., all affording excellent timber in the various arts and the *bark* of which is valuable for *tanning*; The *shagbark*, *pekan hickory*, with their admired fruit; the *nutmeg hickory* and the *pignut*, all affording strong and weighty timber; The *black walnut*, a highly valuable wood and receiving a fine polish; The *butternut*, etc.; The *sugar maple*, affording its vast supplies of sugar; the *birds-eye maple*, for cabinet work, etc.; The *black maple*, the *red maple*, yielding the *curled maple*, so much admired; The *white maple*, the *ash-leaved maple*, etc.; all beautiful trees and highly valuable in the arts; The *button-wood*, or *sycamore*, one of the largest of our forest trees and useful for its timber; The numerous *birches* of both the northern and southern states, the timber of which is light strong and handsome, especially the *black*, or *mahogany birch*; The *red bay* of the southern states, growing to the height of 70 feet and receiving a fine polish; The *sassafras*, abounding in all parts of the country, the *wood* and *root* of which are *aromatic*, *fragrant* and medicinal; the *Am. holly*, abundant in the middle states, and valuable in the arts; The *persimon*, and *papaw* of the southern states, esteemed for their fruits; The various *poplars*, especially the large *carolina* and *cotton wood*, abounding in the southern and western states; the *aspen tree*; The *cabbage tree*, a palm of the Atlantic coast of Carolina and Georgia; The *Am. chestnut*, one of our loftiest trees, with its univalved fruit and valuable timber; The *red beech*, of the northern states, affording a tough and durable timber; The *white beech*, still more widely diffused; The *horn-beam* or *iron-wood*, generally prevailing and valuable for its timber; The *dog-wood*, running from north to south through the Atlantic states, both beautiful and useful; The *sourgum* and *great tupelo* of the southern states, some of great height; The *Am. nettle tree*, of the southern and western states, attaining 70 feet in height; The *hackberry*, or *hoop-ash*, of the western states, of still higher growth and of greater utility in the arts; The *red mulberry*, abounding in the western states, with its agreeable fruit and durable wood; The *white mulberry* and the *black mulberry*, now naturalized and affording their extended harvest for the silk worms of our country; The various species of *ash*—the *white ash* of the northern states, one of the most beautiful and valuable of the American forest trees; The *blue ash* of the western states, and the *black ash* of the north; The Am. *linden* or *basswood*, a lofty and useful tree; The innumerable *willows*, widely diffused throughout our country, both beautiful and useful in the arts; The *Am. elm*, of the northern states, towering to the height of 90 or

100 feet; The *winged elm*, or *wahoo*, and the *slipery elm*, remarkable for its mucilaginous bark; The numerous and valuable *pines*, spread all over our country, at once the most numerous, lofty and valuable of the American forest trees, often lifting its head more than 200 feet, and spreading its towering trunk to 20 feet in diameter; (see article on *Pines* in the 2d part of the work;) The *Am. larch*, or *hackmatack*, of the extreme north, rising 100 feet and affording a most valuable wood, The *bald cyprus* of the southern swamps, attaining a height of 120 feet and affording a strong and valuable wood; The *red cedar* of the south, one of the most durable, light, and compact of woods; The *catalpa*, also of the south, remarkable for its beauty; The *alder*, common to most parts of our country and highly esteemed for its various uses; The *white cedar*, along the Atlantic of the middle states, attaining the height of 80 feet and very valuable in the arts; The Am. *arbor vitæ*, highly durable and allied to the last, with similar good qualities; The *hemlock spruce*, found with the white pine, and a beautiful and valuable tree, rising to 80 feet; The *black* or *double spruce*, peculiar to the north, and with the others much used in the arts; The *white* or *single spruce*; the *Am, silver spruce*, much distinguished for its *balm of Gilead*; The *osage orange*, or *bow-wood*, of Arkansas, its fruit resembling the orange and its wood very valuable; The *locust*, a native of the valleys of the west but everywhere mixed with our trees and the most valuable wood of our northern climate; The *honey-locust*, little less diffused and valuable for its hard timber; The *big laurel*, or *magnolia*, of the southern states, one of the most remarkable trees of America for its majestic form, the beauty of its flowers, and the magnificence of its foliage; The *cucumber tree* of the Alleganies, little inferior to the *big laurel* in beauty and size; also the *long-leafed* and *umbrella trees* of this genus; The *devil wood* of the south; The *wild cherry* of the west, distinguished for its gigantic form;—All these, with others quite innumerable and of little less importance, characterise the soil, forests, and the floral features of the United States, presenting in one broad view the most extended and the richest aspect of productive vegetable nature on the face of the earth.

Further and more interesting particulars of the qualities and productions of many of our forest trees will be found under their respective heads in the 2d part of this work.

A comparison of American and French forest trees shows that in France but 37 species of trees grow higher than 30 feet; while in N. America there are 90 more than 40 feet high. But 18 of the former constitute the mass of forest trees there, while the 90 form the mass here—a difference of 72, or 5 to 1. Of the 90 here 76 are found in the northern and southern states. But 9 of the French trees are suitable for civil and naval architecture, while there are 51 here. The 90 of large growth in America are composed chiefly of 20 *species of*

oaks; 16 do. of *walnuts;* 7 *resinous trees;* 5 *poplars;* 3 *birches;* 4 *maples;* 3 *ashes;* 2 *cypruses;* 2 *elms;* 2 *tupelos;* 2 *honey-locusts;* 3 *magnolias;* 2 *celtis,* nettle, or hockberry. 30 of the 90 rise from 60 to a hundred feet, 57 from 40 to 60, and many of these from 100 to 250 feet.

Topography of Plants.

The situation of plants in regard to local circumstances and the effects of physical causes upon them is a subject of general interest: it is called their *station* in contradistinction to their *habitation,* or geographical position. When found in woods, or mountains, or on the sea shore of a particular country, their *station* is referred to, but the particular country is their *habitation.* Seeds, as we before said, are widely dispersed. Some are unproductive, being deposited in unfavorable positions, while others take root and flourish. Both soil and climate are causes of the one or the other result.

Tribes of plants originate in particular places and increase so as to drive out, or destroy, vegetables of a less vigorous growth, and thus occupy large tracts of country exclusively. These are termed *social plants,* and are thus observed in distinct tribes and of peculiar species in all parts of the world; wherever, indeed, patches of particular plants and of greater or less extent are found growing wild. Some of these, it is said, are constantly at war with their neighbors of different species, each tribe struggling for supremacy until one or the other is victorious. Some herbaceous and perennial plants are thus often overpowered by a colony of shrubs of a taller and more vigorous growth, and these in turn are often compelled to yield to others of still greater power. Such are rarely found mixed; they are sometimes seen in patches at a "respectful distance" either when the contest is going on or when neither is able to prevail. Others, however, which do not increase much by root, and which bear few seeds or are easily dispersed, do not form groups, especially if they have little choice of soil.

Singular plants of certain species occupy exclusively a large portion of country. That curious vegetable, the *red-snow,* found among and nourished by the common snows of the arctic regions, is the only plant there brought to perfection. The truffle is found entirely beneath the surface of the soil, where in Europe it is hunted for by *truffle-dogs* and pigs. There are some *fungi* which plant themselves on the hoofs and horns of dead animals, and on some dead bodies, though never on living ones. Mosses and fungi grow on the dung heaps of animals. A small plant is found upon and is nourished by common paper and even the glass of windows, and other things, when exposed to dampness for considerable time, produce peculiar forms. Cellars and the articles

in them, especially casks that have been filled with wine and other kinds of liquor, and even wine itself, produce peculiar vegetables.

Particular plants are produced on the borders of the ocean, as the *solem* or *maratime* plants, and also near salt licks; these are the *salt-worts* and *glassworts*. They abound in parts of our western country, on the Atlantic and in the interior of Africa and Russia. *Marine* plants inhabit exclusively the seashore and are the *sea-wracks*, and others of the *algæ*, *fuci*, *ulvæ*, etc. *Aquatic* plants grow in fresh water; stagnant and running waters also abound in plants of various kinds, many growing beneath the surface, but all, with one exception, the *awlwort*, rising to the top of the water where they flower, to propagate their species. There are likewise numerous *marsh* or *swamp* plants, *meadow* and *pasture* plants and *field* plants. Many of the latter are introduced in sowing grain. *Rock* plants are those found on stone walls as well as upon rocks. Many upon the latter are in considerable perfection; and the *mosses* upon the former are very extensive, and some are eaten. There are likewise *sand* plants and those of dry moors and heaths. There is an important class of plants which *follow and attach themselves to places inhabited by man*, such as the *nettle*, *dock*, etc., which proceed even to the highest mountains in following human settlements. The forest plants are among those living in society. *Hedge* plants are numerous and well known. *Subterranean* plants, too, are numerous and important, growing in mines and caves, and one yielding a strong phosphoric light. There is also a large class of *mountain* or alpine plants, varying in their character, size and peculiarity of location. The *parasites* are a remarkable class: they attach themselves to portions of other living plants and derive their nourishment from them. These are the *miseltoes*, a species of the *coranthus*, and the *rafflesia arnoldii*, the most wonderful of all products. Many *fungi* likewise subsist on the leaves of plants, some exclusively on the lower and others on the upper sides. A very extensive class of plants is composed of those denominated *pseudo-parasites*, securing themselves by roots to the decayed branches and trunks of trees, as *lichens*, *mosses*, etc., but obtaining their food chiefly from the atmosphere. Among these is a numerous and remarkable family called *air plants*.

The dispersion of plants, whatever the means may be by which it is effected, is constantly going on. Islands in the neighborhood of continents of apparently the same soil contain the same species, but they are not possessed of all the same varieties. This would indicate that they have been separated from the main land and that the diffusion of seeds has been interrupted by the intermediate water. Many plants are thus bounded in Europe by portions of sea, though they reach more distant parts in the same direction by land. Volcanic islands, rising up naked, are in a few years covered with vegetation by the

conveyance of seeds to them, either by water or birds. Some seeds are furnished with wings and down as if intentionally for their conveyance, as the *dandelion*, *thistle*, etc. The *ash*, *fir*, *sycamore*, etc., have membranous wings and others have hooks. The migration of plants is supposed to be facilitated by the currents of the sea. Thus seeds from the W. I. Islands are transported in this way to the coast of G. Britain, Norway, and Ireland. Most frequently, however, seeds are destroyed by the effects of the water, or, from their greater specific gravity, they sink in it.

Currents of rivers also convey seeds to a great distance; so that on the banks of streams are generally found a more varied vegetation than in regions distant from them. Mountainous plants are brought down upon plains by these streams of water; and seeds which do not vegetate on such elevated situations, but are readily caught or intercepted when conveyed by the wind, are thus conducted to valleys where they flourish. The wind, as we have elsewhere said, is also a constant and active means in the dispersion of seeds, particularly the light winged and pappous. Those which have hooked bristles are often conveyed on the coats of animals, whilst wandering from place to place. Seeds conveyed and voided in a perfect state by birds are said to be better fitted for germination than they were before; and in this way they are deposited in situations most favorable for their growth.

Seeds conveyed by man are mostly productive. A ship from Good Hope with bulbs on board was wrecked on the island of Guernsey, when one getting astray, was propagated by the soil which now yields the *Guernsey lily*, so as to afford an important branch of trade in its roots. The potato is said by the Irish to have been introduced into Ireland by the wreck of a vessel on its coast. A species of *artichoke*, introduced by seeds from Europe at Buenos Ayres, now densely covers a space of 900 miles, springing up to the height of 10 feet; and what is remarkable, it annually and suddenly alternates with clover, neither being able to drive the other out. Thus with many other plants when once introduced, they either exterminate the natives of the soil, which is most frequently the case, or they alternately prevail, as in the above case. When one species of plants dies at a particular season, another springs up and in its turn occupies the soil for a brief period.

The extraordinary fruitfulness of some plants in seeds, is also to be considered in the diffusion and propagation of their species. 32,000 seeds have been counted in a single poppy. The elm produces annually 100,000 seeds. Each of these seeds is capable of becoming an individual plant or tree, and if each were to grow up the world might soon be covered with vegetation almost in despite the efforts of man. Thus nature provides against all the contingencies to which seeds are exposed as she does in the perpetuation of animals by the multiplication of their eggs. The queen bee, for example, lays

5000 or 6000 eggs; the smallest herring 100,000; the carp, of half a pound weight, lays 362,000; the small perch 324,600; the sturgeon 7,653,200; and the codfish 9,344,000; yet the proportionate increase, as we see, may not be greater than with higher animals or with plants bearing a less number of seeds or eggs; and the number would appear to be wisely adapted to the contingencies to which they are liable and the probabilities of their failure to produce their kind. With man there is a constant increase, as we notice, over the mortality, though no such provisions are observed, while with the animals before mentioned it is doubtful if any increase is perceptible.

Obstacles to the diffusion of plants are common. Some are found no where beyond a certain spot, as the *trec pink* on the island of Crete, and the *double cocoa* of the isle Praslin, though the nuts have been widely diffused. The *common thrift*, the *scurvey grasses*, and the *rose-root* are found only in rocky places, on shores or the tops of mountains. *Dry deserts*, more than any other cause, intercept the diffusion of seeds and plants. Districts of Africa, separated by burning sand, exhibit widely different vegetation. Mountain ranges also present extended barriers to the dispersion of plants, though their valleys, for reasons before mentioned, are often enriched by various and valuable plants. Plants on one side of a high mountain are very different from those on the other side, as upon the Alps, and also on the Pyrenees. On the eastern side of the Rocky mountains vegetation is not only very different, when it is found on both sides, but there is little or none for a great extent, on the east, while it is most luxuriant on the west.

The natural orders of plants, are very important in their geographical distribution; for this reason we notice a few primary divisions. First, is the *acotyledons* having no *cotyledons*, or seminal parts surrounding and nourishing the embryo of the seeds. These include the *mosses, lichens, seaweeds, fungi, ferns*, etc.; 2d, *monocotyledons*, those with one *cotyledon*, as the *grasses, liliaceous* plants, *rushes, sedges, palms*, etc.; 3d, *dicotyledons*, those with two *cotyledons*, such as *shrubs* and *trees*, and many *herbaceous* plants. Each of these have also other peculiarities; and in numerous instances, a peculiar station and definite geographical situation. Those of the 1st order increase as we proceed from the equator towards the poles, the *ferns* excepted, which most abound in the tropics, in moist, hilly and sheltered places. The *palms* of the 2d order are confined to the tropics, while the others of that order vary; some diminishing towards the equator and increasing towards the north; they mostly abound in the temperate zone, as with the *grasses*. The 3d are most extensively diffused. The *compound* plants of this order are an extensive family and are found on all parts of the earth, but most abundantly in the torrid and temperate zones; yet they vary much in different situations of the former zone. In the frozen zone the proportion of plants of this family is one half less

than in the temperate zone. *Leguminous* plants of this order, of which are the *pea, bean,* etc., abound most in the tropics, diminishing gradually therefrom. Others of this order, such as the *goose-grass, madder,* etc. abound in the temperate region; while those of the *medicinal barks,* etc., are confined to the equinoctial region. The *umbeliferous* and *cruciferous* plants, two extensive natural families, are rare in the tropics, but abound in the S. of Europe.

The habitation of plants presents a wide view of vegetable creation and of the characteristics of plants as regards their natural country or as found in their wild state. In New Holland, we find all the species of the *banksia, goodenia, epacris,* etc., with *acaciæ,* without leaves, but with organs so enlarged as to perform all the offices of leaves. The *fig, marigold, stapelia,* with numerous kinds of *protea,* etc., are found at the Cape of Good Hope. The family of plants to which belong the *orange* and *lemon,* as well as the *camelia* and *Thea* of *China,* are of Asiatic origin. The remarkable *mutisiæ,* with the various species of *fuchsia, cacti, cinchonæ,* or the *medicinal barks,* etc., peculiar to S. America. A few varieties of some of the above and succeeding plants may be found in some other countries, but the general law in regard to locality is not thus overturned. The genera of plants within the tropics on both continents, are generally the same, but the species are as generally different. This is equally true in the temperate climates. In parallels of latitude north and south, on both continents, are likewise found plants with great affinities; i. e., in the south parallels of America and north parallels of Europe.

Vegetable Regions.

From what has been said, a division of botanical regions is easy and natural. There are 20 or 22 of these regions. The *hyperborean region,* the northern extremity of Asia, Europe, and America; *Siberian region,* the great plains of Siberia and Tartary; *Mediterranean region,* the basin of this sea, including Africa to the Sahara mountains, and Europe to the first range of mountains. *Oriental region,* the country bordering on the Black and Caspian seas. *India; China; Cochin China, and Japan; New Holland; Cape of Good Hope; Abyssynia, Nubia, etc.; Equinoctial Africa, Congo, Senegal and Niger; Canary Islands; United States; Western and temperate coasts of N. America; West Indies; Mexico; Tropical S. America; Chili; S. Brazil and Buenos Ayres; and Straights of Magellan.*

Each of these regions is characterized by the facts, 1st, that *one half of a species of plants is peculiar to that region;* 2d, that *a fourth part of the genus belongs exclusively to it;* and 3d, that *individual families of plants are peculiar to it, or have their maxima within it.* These,

again, are named after their particular products, in conformity with the above localities, as

1st, The region of *saxafrages, mosses, gentians, chickweed, sedges, willows,* etc., or *alpine arctic flora,* with an entire absence of tropical families, scarcity of animals, etc. 2d. *Region of the umbeliferous* and *cruciferous* plants. This is European and is separated from the same parallels in N. America; the *fungi, pines,* etc., form a large portion. 3d. *Region of the labiate flowers and caryophilleæ,* to which belong the *pink, catch-fly, sand-worts,* etc. It has a few tropical plants, 1 or 2 *palms, laurels,* the *arum* tribe, *grasses, evergreens,* etc., vegetation never entirely ceasing. 4th. *Japanese region,* in which are 358 genera, 270 occurring in Europe and Africa, and the same in N. America. 5th. *Region of asters and solidagos,* the eastern part of N. America, with about 400 genera. There are, however, the southern and northern divisions. This region is characterized also by the great *oaks, pines,* etc. 6th. *Region of magnolia,* the southern part of N. America, distinguished from the northern by the number of its tropical form of plants, and from the same parallels in Europe. 7th. *Region of the cacti, peppers, and mellastomas,* parts of central America, as Mexico, Peru, Guatimala, W. Indies, etc. The character of vegetation is here remarkable and extensive. 8th. *Region of the cinchonæ,* or *medicinal barks*; this is the middle district of S. America. 9th. *Region of Escallonia, and vacinia,* (whortleberries and winter barks,) the highest parts of S. America. 10th. *Chilian region,* possessing some remarkable distinctions. 11th. *Region of arborescent plants,* with tree-like forms; it includes Buenos Ayres and southern temperatures of S. America, agreeing with the flora of Europe; of 109 genera, 70 being like the European. 12th. *Antarctic region,* including the straits of Magellan; of 82 genera, 59 having species in the northern hemisphere. 13th. *Region of New Zealand;* this has a mixed vegetation, but so distinct in some genera as to claim a division. 14th. *Region of epacoides and eucalypti,* temperate parts of N. Holland, with Van Dieman's Land. This is a remarkable region in its vegetable character. 15th. *Region of fig-marigold,* S. of Africa; its flora is greatly distinguished. 16th. *Region of Western Africa,* with many peculiarities, yet with a mixture of the flora of Asia and America. The *Baobab* of this region is the largest tree in the world. 17th. *Region of Eastern Africa,* with 290 known genera, 196 of which are found in India. 18th. *Scitaminean region;* this appertains to India, west of the ganges, with parallel islands. 19th. *Indian Highlands,* having a very dissimilar vegetation to that of the low lands, and otherwise remarkable. 20th. *Flora of the south of China,* and of *Cochin-china,* its families resembling those of India. 21st. *Region of the cassiæ and mimosæ,* prevailing particularly in Arabia and Persia, of 281 genera, 109 are, however, found in the south of Europe. *Abyssinia* might be,

from its peculiar productions, a distinct region. 22d. *Islands in the South Seas*, within the tropics; it has about 214 genera, but 173 are found in India; others are in common with America. The *bread-fruit tree* is a characteristic of these islands.

It will be understood by the above outlines that *genera* are referred to as the distinguishing characteristics of these regions which, of course, comprehend innumerable *species* and *varieties*. This is a very interesting subject, when pursued farther, but space here admits only of the *names* of the regions, without particulars as to their peculiar and remarkable vegetable productions which are treated in the 2d part.

INLUENCE OF THE ELEMENTS ON PLANTS.

Light, heat, moisture, soil, and atmosphere.

These, like the effect of natural boundaries, determine with equal certainty the fiat, "thus far shalt thou go and no farther." Some plants, it is seen, are found alone in the tropics, such, for example, as the *palms*, the *tree-ferns*, etc. The temperate region contains the *cruciferous* and umbeliferous plants almost exclusively, while the *coniferous* and *amentaceous* flourish in the regions of the north. These with others are all effected by the great physical agents *light, heat, moisture, and soil.*

Solar light on vegetation is no less important than temperature. It produces, indeed, in vegetable life, the greatest variety of phenomena. Plants, it is well known, imbibe less humidity in darkness than in light and consequently the latter greatly influences their character and growth. It effects materially their decomposition of carbonic acid, so essential to their life and growth, and changes their properties and the composition of their organs. In its absence they *absorb* oxygen gas, which gives acid qualities to their productions, while in the light they vigorously perform the important function of giving off oxygen to the air. To its absence also is attributable the phenomenon of the *sleep of plants*. Light is more generally diffused than heat, pervading as it does the cold climates and seasons with little apparent diminution during the day. Its rays are however more oblique, as we proceed to the extreme north, where it is little wanted by vegetation during the winter, as the loss of leaves renders it useless to plants. During the period of vegetation it is, however, almost continuous. Plants, too, which maintain habitually the same position can live in cold climates, where, in summer, light is thus continued; while those species exist at the south which are in the habit, alternately day and night, of sleeping and waking, or closing and expanding their flowers. From this is seen the difficulty of cultivating tropical plants in northern climates. The *vine* fails to ripen in the foggy air of Normandy,

from the absence, not of heat, but of light; hence alpine plants flourish in the rays of the sun, far at the north. They flourish even on a *base* of *ice*, as seen in a valley of the Borneo mountains filled with ice—Some earth having been brought down by avalanches upon it, food is thus grown for flocks in that region. When secluded from light, plants become lax, and send out long, thin and whitish shoots, and in fact become bleached from the effect of oxygen in forming an acid with their carbon, which oxygen they obtain from water but cannot give off. Darkness favors their length by softening their parts while light, by maturing nourishment, consolidates the parts. A due adjustment of their materials, therefore, depends on the balanced alternations of day and night. Plants spring up in the arctic region whilst the sun is constantly above the horizon; and the incessant light acting on them perfects them before they have time to acquire much weight. Direct rays of the sun, we know, contribute more to the flowing of the sap of the sugar-maple than heat—a frost at night succeeded by a sunny day being best for the flow of this juice.

When the temperature is 62° 6′, nature revives during spring in the north, the mean temperature of which is from 42 to 46. The heat most congenial to tropical plants can be imitated and they will flourish in the long sunny days of summer, but in winter, though a high temperature be maintained, they will languish or die. Thus plants are located according to the light they require. Much light is required to stimulate to action all plants of a succulent nature, with watery leaves, few pores, and containing very resinous and oily juices, or which have a great extent of surface. Others, such as *mosses*, *ferns*, and some *evergreens*, flourish best beneath the shade. But we have elsewhere alluded to the effects of light on plants and fruit.

Heat is obviously the most powerful agent in the life and growth of plants. All vegetation ceases in winter if not aided by artificial heat. As they are chiefly nourished by water, or its parts, after decomposition, vegetation is necessarily arrested by a temperature below the freezing point, as it is in deserts where the heat is so great as to dry up the moisture of the earth. Trees, however, having long roots resist the influence of both heat and cold, the soil at some depth being both warmer in winter and more moist in summer. The tree partakes of this warmth in winter through the influence and communication of the roots, as it partakes of the moisture obtained from sub-soils and communicates it to the plant in like manner. The greater the size of the stem or branch, therefore, or the greater the number of layers between its surface and the pith, the better do plants resist the effects of cold and heat. The pith being the softest and most moist part, is most susceptible of these effects, and a tree or shrub, as it grows older, is less liable thereto. Thus the plant, *pride of India* is destroyed by a little cold when young, but when older it sustains four times the

degree of cold. Plants are also fortified against the effects of cold by the amount of carbon and resin they contain, as well as from their clothing of bark, which is readily perceived by its effects on young shoots of fruit trees. Thus also succulent plants, having no distinct bark, are easily destroyed by cold, while the *birch*, which is covered with numerous layers of dry bark, and *pines*, the bark of which abounds with resin, are thereby greatly protected. The latter with others in our northern latitudes, sustain unaffected a temperature of 44° below zero. The extremes of heat and cold in this country are very trying to many plants, especially fruit trees; and, but for their hardy constitution, they must perish by the one or the other.

Temperature, from what has been said, will appear to have very great influence on the geography of plants. It may be considered, in reference to the *mean temperature of the year*, the *extremes of temperature*, and the *temperature of the months of the year*. The 1st is of the least importance generally to vegetable geography, as it affords uncertain data for general conclusions; while the 2d is more definite though less immediately practical, as almost every locality presents peculiarities of vegetation, arising from local heat and other causes. Widely different temperatures or long intervals of extremes enable us to select and cultivate plants with more certainty in intermediate climates. The *vine*, *olive* and *orange* can thus be cultivated, but if left wild to themselves, even in more genial climes, they would not be productive nor withstand the winter. Hence between wild and cultivated fruits of the same kind in different latitudes, there is a remarkable difference. This may be termed the *acclimation of plants*. It is maintained, however, by some that no change in the constitution of plants can be effected by change of climate. The power or property of accommodating themselves to different climates is certainly remarkable. The *vine* is cultivated in Hindostan and Arabia, between the 13th and 15th parallels, also in latitude 51°, and at an elevation of 10,000 feet in lat. 32°.

The greatest importance of heat in vegetable geography is in its distribution in the several months of the year. Great uniformity is observable in some climates, especially on the sea coast, where it is modified by the sea, which is almost always of an equal temperature, thereby enabling even tropical plants to thrive in northern latitudes. Annual plants, requiring the heat only of summer to ripen their fruit and remaining in the state of grain, apparently torpid in the winter, abound in regions where the extremes are great; but perennial plants, which can delay or dispense with maturing their fruit, are greatly affected by the severity of winter. Of these, such as have deciduous leaves best accomodate themselves to inequalties, while those which retain their foliage, or *evergreens*, prefer equal temperatures. Seeds having no substances much affected by moisture are less sensible to

heat and cold, and they may therefore be conveyed from one country to another with safety.

On the eastern continent there are, it is thought, about 160 natural groups or families of plants, the tropical parts of which contain types of the whole, and beyond which they become gradually extinct; scarcely one half appearing in lat. 48°. In lat. 65° there are only 40, and but 17 near the polar regions. In the tropics the woody species, or the trees and shrubs, are equal to the herbaceous, annual, biennial and perennial; but this proportion decreases from thence to the poles; yet the perennial increase over the annual and biennial, so that near the limits of vegetation they are as 20 to 1. The same elevations in corresponding latitudes, do not however equally favor the vegetation of the same plants, as circumstances often modify the degree of heat. The greater the depth of valleys the greater is the cold on the summits of neighboring mountains; hence plants thrive on some which will not thrive on others of the same altitude, and this is likewise true in respect to valleys.

Temperature. The gelatinous, gummy and mucilaginous parts of plants may be converted into sugar. Thus apple jelly treated with a vegetable acid dissolved in water, yields a sugar like that of the grape. So also with the gum of the pea, placed with oxalic acid in a temperature of 125°. The gum from starch, mixed with the juice of green grapes, renders it saccharine, and tartaric acid, aided by heat, produces the same effect: this is the cause why most fruits become sweet when cooked. The production of sugar and of many flavors, oils, etc., in plants with little or no oxygen is attributable to high temperature and bright sun light, while acidity is the result of opposite circumstances. The effect of an excessive high temperature upon unisexual plants, is to cause the production of male flowers, while that of a low temperature is to produce female flowers. Thus the same fruit-stalks may be made to produce male or female flowers, in conformity with these circumstances. Plants are incapable of decomposing carbonic acid or water at a low temperature and without light, and consequently of assimilating their food; they are therefore deprived of their green color, flavor, sweetness, nutriment, fruit and flowers. A preternatural elevation of heat and evaporation of moisture faster than the roots can supply, hastens the secretions, so that the plants cannot elaborate them or furnish parts to receive them, and the old leaves *burn* or dry up and the young ones perish. But this heat and dryness is favorable for certain secretions and the former, with moisture, produces leaves and branches, but these only: hence wheat, etc., are often raised in some climates as grass for fodder only, they producing no seed.

A freezing temperature produces different effects, according to the specific nature of the plants, some being destroyed by it, while others endure great cold. The general effects are that the fluids within the

cells are congealed and expanded, which produces a laceration of the cells, impairs the excitability, expels air from the air-cavities; the green coloring matter and other secretions are decomposed, the vital fluid is destroyed, and the interior of the tubes is thickened. These effects are considered mechanical, chemical and vital, the last two being dependent on the quality of the fluids and organic matter. The temperature at which salt and water freezes varies from 4° to 27°, according to density; oil of turpentine at 14°; oil of bergamot at 23°, of olive 36°, and of annise at 50°; vinegar at 28°, milk at 30°, and water at 32°, thus showing that the fluids of plants resist cold very differently. The air held by water is disengaged on freezing, and crude sap contains much gaseous matter; so that the derangement of the functions, ending in the death of plants, is a necessary consequence of freezing. Such as have a dry tissue and dense secretions resist frost best; hence young shoots are destroyed by a degree of cold which old ones resist. All things being equal, the power of plants and their parts to resist extremes of temperature is in the inverse ratio of the quantity of water they contain and directly in proportion to the viscidity of their fluids; also in the inverse ratio of the rapidity with which their fluids circulate; in direct proportion to the quantity of confined air retained in their organs and the capability of the roots to absorb sap; And their liability to freeze is in proportion to the size of their cells etc.

The excitability of plants caused by heat would soon impair or destroy them, but for a provision of nature against this effect, by the fluctuations of temperature during the day and especially by its diminution at night. The temperature rises with the day and stimulates the vital action of plants and falls at night, when the vital forces are not demanded; so that they, like animals, have their diurnal action and repose. The waste and exhaustion during the day, caused by perspiration under the sun light, is made good by the continued attractions by the roots during the night. Alternations of seasons, like those of day and night, produce like effects. At the end of the season the excitability of the plant is impaired, the vessels and perishable parts are exhausted, the leaves are choked so as to be unable to breathe or digest, the stems are dried up, when they gradually sink into repose on the fall of temperature and the appearance of winter. But they are not dead; their vital actions are not wholly arrested, but only diminished in intensity. Food continues to be thrown into the system, but finding no exit, it gradually accumulates and fills the vessels made empty by the summer's heat, while the excitability of the plant is restored by rest. On the return of spring and a genial sun, their energies are renewed which are in proportion to the food thus acquired. This period of rest and stimulus are provided in hot climates by what are called the dry and rainy seasons.

The great importance of heat in the economy of plants and for the purposes of gardening should be attentively regarded. The temperature of springs affords no satisfactory evidence of that of the surface of the ground, as they mostly come from a distance below, where the temperature is equal at all seasons. The changes within the soil through which roots penetrate should be ascertained monthly, so as to compare the temperature with the state of vegetation. The greatest difference between the mean temperature of the earth and atmosphere appears to be in October, when at a foot below the surface, the former is from one to one and a half degrees above that of the latter. It appears also that in the spring when vegetation commences, the mean temperature of the earth is higher than that of the atmosphere by from one to two degrees and that this difference remains thus higher in autumn; by which the condensation of the tissue and secretions of perennial plants against the approach of cold weather is effected. The average difference of temperature between 1 and 2 feet below the surface is as 48.87 to 50.15, the atmosphere averaging 48.26. The comparative difference in hot latitudes is often very great, as in the tropics, where the temperature, just below the surface, is often from 126° to 134°, while that of the atmosphere is 84.5; in France 118–122°, atmosphere 91.5°; C. Good Hope, 59° and in the shade 119°, atmosphere 98°. The mean temperature of the state of New York, for 14 years has been 44.31°, Fahr.; the lowest mean for a single year was 44.11°, and the highest 49.99°. The mean temperature near this city during the coldest month (January 1839) was 28.89, and of the warmest (July) 70.69°. At Albany the mean of January was 23.38°, and of July 72.38°. It is calculated, on the whole, that the mean difference of temperature between the earth and atmosphere, as before noticed, is uniformly from 1 to 2°.

Moisture has not only an important effect on vegetables, but is an essential element of their substance. Those having a large or spongy cellular tissue necessarily absorb a large amount of water, and also those with soft and broad leaves, provided with many cortical pores, and likewise those with long and numerous roots. Such cannot live without an abundant supply of moisture. Nor can those live in moist and damp places which have a compact tissue, with small leaves having few pores and clothed with hair, nor yet those depositing much oily or resinous matter. The more water abounds with substances which obstruct its passages, the slower will be its absorption. These substances more or less effect the topographical distribution of plants. They consist mostly of carbonic acid, atmospheric air, alkaline earths and animal and vegetable substances. Plants containing much carbon, such as those producing hard wood, avoid water that is mostly free from carbonic acid gas, but the *fungi*, as the mosses, etc., prefer such situations; so also those requiring other materials for their com-

position will select situations most favorable for their supply and near such waters as contain them.

Heat and Moisture.

The evidence of something like a "bottom heat" in the greater temperature of the soil over that of the atmosphere and the marked vigor of plants growing near hot springs, or subterranean fires, may have induced the practice of employing hot beds in cultivating delicate plants and in producing valuable seeds. But this cannot be applied beneficially by art when such plants are natives of colder climates. The soil in which are to be raised tropical plants is to be permanently elevated to at least 75° or the seeds will not germinate; or, if they do, they present a sickly appearance. Hence they cannot germinate at the ordinary temperature of our soil as it seldom rises, even for a short time, above 65°. But the intensity of bottom heat depends nevertheless on the constitution or species of the plant and the known temperature of its native climate, a little above which the heat should doubtless be raised, in order to secure the original properties of the plant. Hence the failure to raise successfully oranges in tubs when the soil cannot be above 66° and in winter sinks to 36°, while that of the soil where they flourish is from 80 to 85° and never falls below 58°. The same may be said in respect to the vine. The necessity of the soil-temperature being above that of the atmosphere accounts for the fact that ornamental trees in our parks and elsewhere, when paving stones are placed around them, frequently die or fail to flourish, because the earth, instead of being warmer, is thereby kept constantly colder than the atmosphere. If the bark of a fruit tree be stripped off in spring, while the bark is loose and a new layer of inner bark is forming, and a frosty night or cold wind occurs, the inner bark becomes again firmly attached; and, although the tree may appear healthy and sustain its foliage and blossoms, and its fruit set well, yet nearly the whole falls off at the time its growth should commence.

The moisture and temperature of a soil, more than its mineralogical character, is believed to determine vegetation. A distinguished gardener soaks the roots of fruit trees in a mixture of equal parts of boiling and cold water, and sprinkles the trees when necessary with lukewarm water. This is attended with great success. The success of the Dutch gardeners is also attributed to their application of heat to the roots. Tan-bark beds are the usual source of bottom heat. The importance of water in vegetation is that it supplies the plant with the elements of its food and is the means by which the soluble parts are conveyed into the system of plants. The object is to learn the amount required and the periods at which it should be applied; plants evidently require an abundant supply during growth; and in

winter no more generally than what results from the capillary attraction of the particles of the soil. The younger the leaves of plants the more active their perspiration. A constant supply of water renders the parts of plants succulent, as with the leaves sent to the table, and also fruit. To effect this artificially, or its appearance, market-gardeners and hucksters are in the habit of pouring copious and frequent showers of water upon them, but generally at the sacrifice of their quality. The quantity of water in the soil of succulent fruits should be diminished when they are ripening. The solar light should correspond with the quantity of moisture, otherwise the tissue becomes disorganized. When in great excess water gives to plants a yellow appearance, owing, it is thought, to the destruction by water of the blue matter, by the mixture of which with yellow parts the green verdure of plants is formed. Undue moisture about the roots is relieved by draining and no good fruit can grow in soils imperfectly drained. It has been thought, too, that the watering of plants artificially in the open air is of very questionable advantage, as the air is not furnished with corresponding moisture. The roots are thus but momentarily excited while the sudden evaporation from the soil produces cold, and the surface becomes incrusted, which are not the results of watering by natural showers. In late spring planting it is far better to water in the hole. In the case of annual plants only is watering recommended, and then chiefly by inundations through sluices etc. Copious watering thus prevents mildew.

Atmospheric moisture varies greatly in different regions, while the constituents of the air rarely vary; yet these are intimately connected. The effect of excessive perspiration in plants is to dry up their juices, while an obstruction of the perspiratory organs, the leaves chiefly, prevents the assimilation of fluids and the formation of new matter. This is closely analogous with the same process in the animal economy. An atmosphere which maintains perspiratory action in the most uniform and healthy state, is that most desirable. By Daniell's hygrometer all the points of moisture may be ascertained, which will be found of great practical importance. The changes of moisture extend in this latitude from 1000, or saturation, to 389 and often lower. The mean depth of rain and snow in this state (N.Y.) for 14 years has been 84.40 inches. The highest average from 54 stations for one single year (1827) was 44.40, and of the lowest (1839) 22.10 inches. In London it is 24.01; St. Petersburg 16; Algiers 27; E. Indies 31 to 64; Madeira 31; Bahamas 54.99; Calcutta 59.83 to 81; Ceylon 84.3; Macao 48.8 to 107.3; Equator 96; Coast of Malabar 123.50; Grenada 126; St. Domingo 150; Bengal 20 to 22, in a single month; Bombay 32, in 12 days, and in Savoy 205 inches in 6 months, or 8.5 in a day, oftentimes!

The effect of wind is to increase in the same ratio the dryness of

the air; and the perspiration of vegetables; so that anything retarding the force of the wind diminishes, of course, the perspiration. A surface exhaling 100 parts of moisture in a calm air yields 125 in a moderate breeze and 150 in a high wind; hence the advantage of walls and screens to break the force of wind. The difference in fruit trees trained upon the walls and in exposed situations is owing principally to this circumstance. The amount of evaporation 43 feet from the ground, is annually about 37.85 inches; the evaporation guage being placed lower and less exposed the annual average is 33,37 and when the guage is near, or upon the ground, it is 20.28 inches. The easterly winds are said to be the coldest and dryest in England. The mean temperature, dryness and moisture of the air with respect to the wind, as appears from observations in the London Horticultural Society is *south* wind; temperature 51.4; dryness 4.2, moisture 8.77. South wind; temperature 52.2; dryness 4.7, moisture 8.59. West wind; temperature 51.3; dryness 6.2; moisture 7.33. North wind; temperature 46.2; dryness 6.0; moisture 7.49.

The radiant power of heat may be advantageously modified by screens. By these the radiant heat of the sun is intercepted and returned into space; thus the perspiration and the temperature surrounding a plant are diminished; the radiant heat of the earth is also intercepted and returned to the earth. Thus the temperature may be modified, when necessary, by art. In northern climates garden walls are often blackened by which plants near them are favored in their growth by the increased heat. Cold air being heavier than warm, a great difference will be observed in plants growing in a valley and on more elevated situations. This however is less remarkable in the wide valleys of the U. S. especially those of our rivers and lakes. The valley of the Hudson, with from one half to one mile marginal width, is protected from autumnal frosts; but beyond that, plants suffer much. The warm vapor rising during a cold night from the water is thought to protect adjacent shores. Our large lakes thus have an important influence on the neighboring soil. A garden placed on a gentle slope having a southeastern aspect, with a running stream at its base, secures the greatest advantages of position. Plants in this climate, however, where the frequent bright suns of winter temporarily thaw the plants, a more northern aspect is preferred, especially if they are not covered by matting, straw, or boards during the winter, which, with all delicate plants, should not be omitted. The air in warm climates is generally filled with vapor to a greater extent than in colder ones, though it is occasionally more dry; hence the object of glazed houses is to effect the same conditions, when provided with hot water pipes. As general rules, moisture is most required when plants begin to grow, and least when their growth is completed; 2d, the atmospheric moisture required by plants; all things being equal,

should be inversely proportionate to the distance of the countries they naturally inhabit from the equator; 3d, plants with annual stems require more moisture than those with ligneous stems; and 4th, the amount of atmospheric moisture required by plants at rest is inversely proportionate to the water they contain at the time. Thus succulent plants when at rest require a dry air. Much attention has been paid to ventilation and other particulars connected with the growth of plants, but these do not fall within the scope of the present chapter.

The influence of soil on plants, in a general point of view, is well known. Its consistence, as a predominant quality, varies in different parts of the earth. The light and drifting soil of deserts can, at best, support only humble shrubs, while that of a compact nature, which distinguishes large tracts of country, sustains plants of a large and lofty growth. Extremes of loose and compact soils are therefore equally devoid of vegetation. Water or wind may equally affect the one while the other is impermeable to the roots of plants. The chemical nature of soils, or the rocks which compose them, is the general cause of the local distribution of plants. These are composed of the constituents of neighboring mountains. Hence, as a general rule, the character of the soil may be known by that of rocks composing the mountains which would most naturally, from their situation, conduct water upon the soil. The materials for this will be such as constitute the elements of plants flourishing upon it. Other soils are deposites from water which have formed at distant periods various kinds of earths from distant situations, either as a running stream or as a portion of the sea. Vast tracts of country are deposites from the sea, thus forming immense deltas, islands, etc. The peculiarities of soil are consequently as various as were the causes which produced them; and the combination of materials which those causes must have effected in the progress of many ages, was therefore greatly varied and singular.

How diversified soever the agents may be which contribute to the growth of plants, it is certain that they will not grow in any climate, if the soil be devoid of the elements essential to their composition. Soil must be so constituted as to absorb water more or less readily, retain it with more or less force or part with it with greater or less facility. In a dry climate it should have the property of absorbing moisture most readily, and in a humid atmosphere of resisting it to a great extent; yet this is to be considered in reference to the nature of the plants grown on the soil. Every kind of soil has these properties in a greater or less degree. Some are more or less readily pulverized and others, from their nature and color, are more or less readily heated; or they retain their heat longer or shorter.

The influence of the atmosphere both upon the growth and distribution of plants is of the greatest importance, for they can no more exist without it than without a soil. It is from the atmosphere that they

extract their chief support. The carbonic acid from which they derive so much of their solid carbon is obtained principally from the atmosphere, as well as their nitrogen and ammonia. Hence their distribution is more or less affected by the materials within the atmosphere. Saline particles abound in certain parts, especially in the vicinity of sea water. From these is derived the soda necessary for the support of certain kinds of plants. Many indeed can exist nowhere else, nor without this alkaline salt. An important general influence is likewise exerted by the air on plants by its hygrometic action, or its property of retaining and imparting moisture. The motion of the air and consequently that of plants, doubtless exerts a salutary influence on the health and vigor of plants by the wholesome exercise thus given. Its rarity or density, has also a very important effect on plants. Rare air has a greater capacity for heat than dense air. Hence the condition of the atmosphere at different elevations, in its effects upon plants which are less affected by heat in temperate climates, is important. The potato, which flourishes in plains with us, grows in Peru at an elevation of 10,000 feet above the sea, but the *olive*, growing at 44° N. will not grow above 12.50 feet. A less degree of moisture exists in proportion to the greater degree of height. The general effect of elevation on the growth of plants is however in the diminution of temperature. But the most general influence in the distribution of plants by the atmosphere is in its conveyance of seeds. These are, it is well known, widely diffused by it, and very many plants have thereby been tested as to their capability of growing in various climates and parts of the world. That it has been thus instrumental during high winds in distributing plants and inducing their growth, where otherwise they would not have grown, must be apparent. It likewise affords the means by which birds become agents in their diffusion.

General Remarks.

The adaptation of vegetable productions to the peculiar constitution of plants is not more remarkable than it is to the necessities of man and other animals. The luxurious profusion of vegetable nature in the tropical regions; the less vigorous and prolific powers of plants in the temperate zone and the scanty and stinted productions of the polar circles, prove the same wise adaptation of nature to the requirements of human society and the necessities of animals and of plants themselves. But it is natural for men to conceive their own latitudes best supplied with plants. The ancients of the temperate climates thus conceived the torrid and frigid zones to be uninhabitable; and the people of the tropics may readily imagine that, on departing from the track of the sun, the great source of vegetable life, they must meet with nothing but sterility and death. But, though most

tropical plants will not flourish in more northern latitudes, yet these latitudes are, nevertheless, well provided with such as are essential to the life and vigor of animals. In approaching the frozen zones both animals and plants diminish; hence vegetable life every where keeps pace with that of animals. But though we lose sight of valuable plants, it is only because they are not required; whilst we find at the same time others which are required and which are even of greater value to the particular wants and the diffusion of men and animals; and this not only by indigenous plants, but by the susceptibility of tropical plants to yield to the change of climate.

Indigenous plants of both continents we see maintain the laws alluded to. At every step, north or south, the groups of plants change in accordance with the circumstances of life. In central latitudes we find the nativity of the clove, the nutmeg, pepper, mace, cinnamon, the odoriferous sandal wood, the teak, the ebony, the banyan, etc., in similar latitudes; but in another district are found balm, myrrh, frankincense, tamarind, coffee, and more northerly, the important grains, the peach, the apricot, citron, walnut apple, chestnut, plum, pear, etc. Thus we may wander from one region to another, south, north, east or west, and find the groups of plants differing in their kinds, yet always corresponding with the diffusion, the necessities and the interests of both animal and vegetable life.

The vegetable food of the people of every country varies with the productions in each. Nature, in the hot climates of the south lavishes her vegetable stores; but art and industry have abundantly furnished the temperate climates, not only with necessaries, but luxuries; so that many of the productions of a more genial clime are here little less valuable as necessary or luxurious food. Thus the grape, and the melon are not inferior here to those flourishing in their own native soil. Yet it is remarkable that so little attention is paid here to the transplanting and improvement of many important fruits and vegetables of other countries.

The cultivation of the soil presents a marked distinction between races and nations of men. Wherever this is most the object of their attention and ambition, there man is found most advanced in intelligence and morals. And whoever contributes to the arts of vegetable culture, or adds a new species of plants for useful cultivation, adds a lasting blessing to his own species and a never-fading laurel to his brow.

Wherever vegetation is abundant it preserves the soil from the desolating effects of the elements; and where cultivation is most successfully prosecuted, there health, comfort and civilization follow. The improvement of climate, as well as of the social and christian virtues, keep pace with the arts of agriculture; and wherever industry is free and property secure, there less government is required and fewer pre-

cepts are necessary. There, too, famine and epidemics occur less frequently and the fluctuations of trade and the revulsions of productive industry are least felt. The introduction and cultivation of a single seed often sways the destiny of whole nations, and may change the aspect of the whole world. The potato, rice, cotton, and a blade of wheat are examples in point of the effects produced by vegetable products and cultivation. And when we see that a seed not larger than a pin's head is elaborated by nature, within a brief season, into a flourishing root twenty millions of times larger than its present grain, we cannot be insensible to the arts of culture, the principles of nature, or the power and wisdom of the benificent Author.

Some plants, it will be seen, are evidently destined to render the earth cheerful and beautiful, and others are distinguished by their great utility as food for man and beast, while a very great number are both useful and beautiful. Trees are such as to afford us hard wood, as the oak, apple, and elm, and many others afford soft wood, as willow, poplar, etc., while others afford us gums and resing, as pines, fir, etc. The hard wood is best for fuel, giving out the greatest heat, as it has the most carbon, while resinous woods burn most freely from the greater quantity of hydrogen which they contain.

Not only are the differences in vegetable products admirably calculated both for the support and gratification of our physical nature, but those of different climates and countries have an important influence on the moral and social condition of man. This is perceived in the study of natural history, the discovery of new and valuable productions, the extension of commerce and the establishment of colonies; thus extending the comforts, the arts and literature and the general prosperity of whole nations. The desire to possess the different products of different countries stimulates alike the merchant and the traveler; and the introduction thereby of a few new seeds has essentially changed the condition of the people of large and populous countries. Almost all of the most valuable vegetables have thus been introduced from other countries. It is by marking these facts and reflecting upon the attendant circumstances that we become impressed with the importance of our subject.


GREENLAND
BAFFIN'S BAY
Gooseberry
Willow
Birch
Turnip
Cabbage
Slave Lake
Gooseberry
Raspberry
Pine
Birch
Maple
Apple
Alder
Dwarf Birch
Larch
Poplar
Pine
Willow
HUDSON BAY
LABRADOR
Nain
Barley, Rye,
Hemp.
Lake Winnipeg
Pines
300 feet high
Columbia R.
Rocky Mountains
CANADA
Occidental Arbor Vita
Weymouth Pine
Hops
Sugar Maple
Oak
Apple
Pear
Sassafras
Garden Vegetables
Red Maple
Cranberry
Chestnut
Walnut
UNITED STATES
Arbutus
Rhododendron
Magnolia
Tulip Tree
Deciduous Cypress
Limit of Live Oak
Pseudacacia
Limit of Hickory
Tobacco
Red Cedar
Aloe
Rice
Cotton
Orange
Indigo
Brazil Wood
Sugar
MEXICO
Wild
Tiger Flower
Lobelia
Splendens
Sunflower
Dahlia
Maize
Jalap
Ane
Apple
Plantain
Cacao
Pastic
Logwood
GULF OF
MEXICO
Tamarind
St Domingo
Jamaica
Allspice
Lignum Vitæ
or Quincum
Sugar
Coffee
Ginger
Annotto
Yam
Quassia.
Capsicum.
Cocoa Nut
Mahogany


Cocoa Nut
Balsam Tolu
Cumana
Cactus
Mimosa
Demarara Sugar
Indigo
Cayenne Pepper
Pine Apple
Vanilla
Plantain
Quinine
Parasitic Orchites
Heliotrope
Jatropha Manihot
(Tapioca)
Hevea Indian Rubber
Balsam of Copaiva
Ipecacuana
Sarsaparilla
Peruvian Bark
Potato
Lima
Yucca
Scarlet Fuchsia
Nasturtium
Plantain
Cacao
Yam
Love Apple
Passion Flower
Cacao
Jerusalem Artichok
Dragon's Blood
Maize
Mango
Cotton
Vanilla
Tamarind
Yam
Rio Janeiro
Coffee
Olive
Olive
Vine
Buenos Ayres
Southern Limit of Tree Ferns
COLUMBIA
PALMS
PERU
BRAZIL
UNITED PROVINCES
CHILI
PATAGONIA

We have noticed in a brief view of the forest trees of our country some of the boundaries of its vegetable productions; and as we have not space to say more in reference to American vegetation, we here add a map of the vegetable regions of the new world, which illustrates what has been said and conveys a comprehensive view of what we might further say on that interesting subject. Indeed, no description, we are convinced, will so well present particular regions and stations of plants throughout our continent as this. Cultivated plants, it will be seen, are distinguished by roman letters, and those growing wild by italics; those which are native or indigenous, and those which are foreign or exotics are also distinguished.

It will not be supposed that the plants named grow exclusively in the spots designated, or that they are not to be found on the eastern continent. We show the situations in which they thrive best here, or more properly their *natural situations*, whether cultivated or growing wild. The plants mentioned, are confined to those cultivated mostly in the garden, or employed in medicine or in the arts.

The attention of naturalists has been much engaged lately in the geography of plants, and the subject is one calculated to interest all others having a taste for the study of nature. Of the vast number of species few belong indiscriminately to all climates or situations, but are located, as we have before observed, according to certain peculiarities of organization, or their habits and requirements, as animals evidently are. Although the climate, on both continents may be strikingly similar, and other circumstances to all appearance the same, yet very dissimilar plants will inhabit one or the other. Those, too, which originally belonged to particular parts of the world are found, when removed, to enjoy their new home quite as well as their old one, and even better; as the potato, the grains, etc.; while others pine and die, or continue a dwindled type of their original, or change their nature essentially.

The temperate region comprehending our country is remarkably distinguished by the variety, splendor, and value of its vegetable productions, compared with those of the same latitudes on the Eastern Continent. The form of our continent and disposition of our mountains admit of a far greater intermixture of vegetable productions than the warm and cold climates of the old world. No where else do the cereal grains, or natural families of grasses, taken collectively, or the Leguminous plants, so valuable for their *pod*-fruits, grow in so great a perfection, or afford such abundant supplies of food for man and the lower animals as in our country. In this respect we enjoy the principal advantages of every climate on the earth; a privilege, or national and natural blessing realized by no other people. Well did the learned and enthusiastic Humboldt say, in view of this fact—"*It seems as if nature had labored to adorn the Land of Freedom!*"

CHEMISTRY OF AGRICULTURE.

The character of soils and the nature of vegetable constituents are interesting subjects of study with all who admire the works of nature and who love to investigate her laws. It is an important object with the practical agriculturist; and it should be so with every well-wisher to human happiness, to produce the best and the largest quantity of useful vegetable products on a given surface of soil. An examination therefore, into the means which nature has provided for this purpose, and the arts and late discoveries of scientific men in effecting so important an object, cannot be without the deepest interest to the general reader as well the cultivator of the soil; not only as it explains the remarkable functions and properties of plants, but as it discloses their not less remarkable adaptation to the requirements of animal and human life.

It will have been seen in previous chapters that the soil is composed of two kinds of substances, *organic* and *inorganic*. The former consists of parts of animal and vegetable matter, and the latter of earthy or rocky substances. The organic matter is generally capable of being burned and the parts driven off by heat, while the inorganic is commonly fixed and incapable of being dissipated in that way. Plants which grow upon such soil must therefore contain portions of these substances. From 3 to 10 per cent. of productive soil is thus composed of organic matter; and the ash of vegetables, when burned, show the amount of inorganic matter, which is generally from 20 to 50 per cent. The soil, if heated red, will show no great diminution of bulk, but if the stalk of wheat be burned there is very little product. This, in a ton of wheat straw, is about 300 lbs., and in that of rye, 200 lbs. But a ton of wheat *grain* yields but 40 and that of oats 90 pounds of ash or inorganic matter. The organic matter which vegetables have acquired by assimilating the matter of the soil, constitutes, therefore, nearly its entire weight. The ultimate elements of this matter, as we have before stated, consists of carbon, hydrogen, oxygen and nitrogen. Thus some common plants, when dry, consist of the following proportions, in pounds, of a 1000 lbs. each :—

	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ash.
Wheat straw	485	52	389	31	70
Oats	507	64	367	22	40
Potatoes	441	58	439	12	50
Hay	458	50	387	15	90

Hay, if dried by a gentle heat, loses of the 1000 lbs. 158 lbs. of water; potatoes, wiped dry, 722 lbs.; wheat 260, and oats 151 lbs. Potatoes and turnips are said to contain about 4-5ths of their weight of water.

The elements of these and other plants are chemically combined, not mixed, for if they were placed together no art could make them wheat or hay: they are driven into the air, by heat, in a state of gas, the ash excepted, and the plants are thereby decomposed. These elements again enter into the food of plants, through their roots as water, manure, &c., or through their leaves as gas. Carbonic acid is the principal element imbibed either way, and this consists of 72 parts of oxygen and 28 of carbon. It has been said that the quantity of ashes yielded in burning, varies in different plants: thus rye-grass in a 1000 lbs., yields 17 lbs.; red clover 16, turnips 8, barley 25, carrots 7, white clover 17 lbs., &c.; consequently the quantity of inorganic matter required by plants varies in like manner. The quantity of ash or inorganic matter likewise varies according to the situation in which plants are grown. In 1000 lbs. of wheat straw this has varied from 35 to 155 lbs. Soils possessing least of this matter will not therefore support plants requiring most. Trees, having little inorganic matter, grow best on soils where arable crops will not. A 1000 lbs. of elm wood, when burned, leave 19 lbs. of ash, of willow 4½, beech 4, birch 3½, pine 3, and oak 2 lbs.

The whole plant is estimated in noticing the amount of ash, but different parts of a plant possess different proportions of ash. Thus a 1000 lbs. of turnip *root,* sliced and dried, yield 70 lbs of ash, while the dried *leaves* yield 130 lbs. The *straw* of wheat yields 60 lbs., while the *grain* yields but 12 lbs. The leaves of the woods above-mentioned yield ash in like greater quantities than their wood. The inorganic matter which it will be seen is withdrawn from the soil by the plant, may be returned to it again in the state of manure and in the fermented straw. Nature returns it in like manner by the fall of the leaf. Thus, it is apparent, that those soils produce most perfect plants which best supply all their wants.

But the quality as well as the quantity of the ash left by plants, after burning, is also to be considered. That of one plant may have much more lime, that of another more potash, another more soda, and another more silica. The ash of bean-straw, in 1000 lbs., is 53 lbs. of pot-ash and 7 lbs. of silica, while that of barley contains 3½ lbs. of pot-ash and 73½ lbs of silica. Wheat contains 19 lbs. pot-ash, 20½ soda, 8 lime, 8 magnesia, 2 alumina, 34 silica, 4 sulphuric acid, 3½ phosphoric acid. Other plants vary much in the proportions of these constituents. Oats contain but 6 lbs. of pot-ash, 5 of soda, &c., and the different parts of plants contain these in various proportions, so that one carries off from the soil very different quantities

of the above elements; consequently the soil cannot suit all kinds of plants while it may be well adapted to particular kinds. Hence the importance of a rotation of crops requiring these elements in different proportions. One kind of soil, it will be seen, may ripen the straw and not the ear, or the ear and not the straw.

The amount of inorganic matter required for the crops of 4 years, per acre—say 1st year 25 tons of turnips and 7 tons of the tops; 2nd year 38 bushels of barley and 1 ton of straw; 3d 2 tons of clover and rye-grass, and 4th 25 bushels of wheat and 13 tons of straw, would thus be 12.40 lbs. in the following proportions:—pot-ash 281 lbs.; soda 130 lbs; lime 242, magnesia 42, alumina 11, silica 318, sulphuric acid 111, phosphoric acid 61, and chlorine 39 lbs. According to this it is supposed that, to restore these elements to the soil by manuring or otherwise, each acre requires, every 4 years, pearl or pot-ash 390 lbs; carbonate of soda 440 lbs.; common salt 65 lbs.; burned lime 240 lbs.; epsom salts 250 lbs.; alum 84 lbs.; bone dust 280 lbs.

The importance of liquid manures from the farm yard will be apparent for some of these constituents. Some soils or sub-soils, however, contain, no doubt, a general supply of these substances, and the elaboration of the elements obtained from the air also furnishes some of them; hence the waste is not readily perceived, while other soils are soon exhausted. A century even may not exhaust these substances, but a gradual, if not rapid, diminution of them must take place.

Of the organic portion of soils, we have said vegetable and animal remains constitute the chief substances. These vary greatly, and are furnished by vegetables decaying upon them, by manures or by streams of water. This is the *humus* before spoken of. In peaty soils they are said to constitute, oftentimes, from 50 to 70 per cent., by weight. Rye and oats grow on soil which contains but 1½ per cent., while wheat soils contain from 4 to 8 per cent., and in very clayey and stiff soils 10 or 12 per cent. is sometimes found. The upper soil is said to be often overloaded in very old pastures and gardens. The humus thus furnished the soil by the decay of organic matter, is of the first importance. The animal matter chiefly supplies the ammonia and nitrogen, so important in plants.

The inorganic matter before noticed, consists of *soluble* or saline substances and insoluble or earthy substances. Thus, if the soil be dried in an oven, and a pound of it well stirred in 1½ pints of pure boiling rain water, the liquor allowed to settle and then is poured off or boiled away, a portion of saline matter will remain, which may be from 2 to 20 grains. This is the soluble matter or portion of the soil, and consists commonly of sulphate of soda or glauber salts, common salt, sulphate of magnesia, or epsom salts, with small portions of chlorides and nitrates, which are detected by chemical tests.

These soluble or saline ingredients constitute the chief parts of the plant which are left after burning it. If but a single grain of this saline matter be found in a pound of soil a foot deep, it is equal to 500 lbs. to the acre, which is thought to be more than is taken from the soil by the rotation of crops during 40 years, where the straw and herbage is uniformly returned to the soil in a state of manure. The soil in some places forms an incrustation on the surface, especially when the sub-soil contains much water. Water evaporated from the soil leaves behind the salts which it always contains, and is the cause of the saline incrustation. This, falling with the rain and descending to the sub-soil, deposits its salts when evaporated. Hence the surface is better supplied with them in dry weather, early in the season, for the growth of young plants, and when the roots have penetrated further, they bring it up from the sub-soil by decomposing the water.

Insoluble or earthy parts form, generally, about 90 in the 100 parts by weight, of soils. These are principally *silica*, or sand, *alumina* or clay, and *lime*, or carbonate of lime, with 1 or 2 per cent. of oxide of iron, or even much more in red soils. Magnesia and phosphate of lime are also found. Plants are classified according to the quantities of these substances they contain. The proportions of sand and clay may be found by boiling, say an ounce of the soil in a pint of water, till it is quite softened and diffused, then shaking it and allowing it to stand for a few minutes, when the sand will subside while the finer clay will float, and it may then be turned off into another vessel. This, when perfectly clear, may be turned off, and thus the sand will be in one and the clay in the other vessel, and they may then be dried and weighed. If a 100 parts of the soil contain not over 10 per cent. of clay, it is a *sandy soil*; if from 10 to 40 it is a *sandy loam;* if from 70 to 85, a *clay loam*, and if from 85 to 95 it is a *strong clay soil;* and if no sand is found, it is a pure *agricultural clay*. Strong clay soils are used to make bricks, and agricultural clay is *pipe-clay*, or used in making pipes, etc. Pure clay consists of about 60 parts of silica to 40 alumina, chemically combined. Arable soils rarely contain over 35 per cent. of alumina. Soils containing but from 5 to 15 per cent. of sand, cannot well be brought into a state of cultivation.

Soils containing more than 5 per cent. of carbonate of lime are called a *marl;* if more than 20 per cent., a *calcarious soil*. Soils in which vegetable matter greatly predominates are *peaty soils*. The quantity of carbonate of lime in a soil is estimated by burning the soil to redness in the air, and weighing, say 100 grains, stirring it well in half a pint of cold water, mixed with half a wine-glass full of muriatic acid, or spirit of salt, allowing it to stand for 2 hours, occasionally stirring it—then pour off the water, dry the soil, heated again to redness, and weigh the product, when the loss will be the amount of

lime the soil contained. The amount of vegetable and other organic matter in a soil is found by drying the soil well upon paper in an oven, then burning a weighed quantity in the air, and the loss is the organic matter. In stiff clay soils the loss will be in part water, not wholly driven off by drying.

Geological Character of Soil.

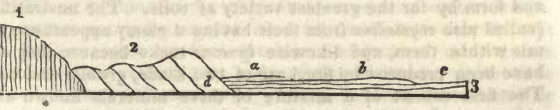
The character of sub-soil should always be examined; and the season of the year at which the examination is made, whether dry or moist, in spring or in summer, are also subjects of much importance in purchasing or renting land. By digging down with a spade 18 inches in various parts of the land, the sub-soil may be known. In digging through the soil and sub-soil, we arrive at length, at a greater or less depth, upon the solid rocks. In some cases these rise to the surface, or very near it, and in others they are far below it. These rocks are very unlike in character, composition and hardness. In one place they are a sand stone, in others a lime stone, a slate or hardened clay, etc. Any of these left exposed to the action of rains, frosts and winds, a considerable time, are seen to disintegrate, crumble and waste away, and the minute fragments form soil in which plants are seen to spring up. Hence the soil partakes of the character of the rock. If this be sand stone, the soil is sandy; if clay-stone or slate, it is more or less stiff clay-soil; if limestone, it is more or less calcarious soil, and if these are mixed, it is a mixed soil. As the soil resembles the rocks on which it rests, the conclusion is that the rocks at one time were uncovered, and that soil is the result of the gradual wearing away of the rocks.

The position of the rocks accounts for the circumstance why large tracks of land are of the same composition, oftentimes; while in other places it changes frequently in short distances. Rocks are distinguished as *stratified* or *unstratified*. The first lie *over* each other in separate beds or layers, the second form hills, ridges, or mountains, and consist of a solid mass. The position of rocks, as they may commonly be found, will be seen by this illustration:—



This indicates unstratified and stratified rocks laying horizontally over one another, as at *a b c d*. The soil at 1 and 6 may of course be different from that of the horizontal layers, and these in turn may be different from each other. The small valleys, 2 3 4,

exhibiting the undulating character of the plain, and also the more elevated part at 5, may rest upon similar or dissimilar rocks, according to the order of superposition. At 2, 3 and 4, the soil will be different for a short space, and at 6 the perpendicular rock rises to the surface. Thus the undulating character of the land brings to the surface different kinds of rocks which produce corresponding differences of soil. Generally these valleys have been produced by water, which has washed away parts of parallel layers of horizontal rock. A more diversified soil may be seen in the next cut, where three different inclinations of rock are perceived, at 1, 2 and 3.



On the plain from *a* to *b* a change in the soil would appear, and also at *c*; though, from the extent of the plain no special elevations may be noticed. But on rising the hill at *d*, the soil would present a different character, until arriving at 2, where the edges of the rocks would present other changes in the soil, and these may vary with every inclined layer there noticed. Again, at 1, the perpendicular layers are much thinner, and the soil, consequently, may there vary with every bed in the group, or the whole may be mixed.

The natural order in the position of stratified rocks is also to be considered. Thus at *a b* and *c*, in the first cut, there may be sandstone, lime-stone, or slate, and *wherever these or any one of them are found, they will always have the same relation to the rocks above and below.* So that knowing this relative position and finding a particular bed on the surface, you will know what rocks are below it and the order of their superposition. No where, for example, will the rocks *a* or *c* be found above the rock *d*. Thus the relative age of each rock is determined, the lowest being always the oldest; and thus also in digging or sinking a shaft you will know from the uppermost rock what rocks, in their order, you will meet with. This is useful to the agriculturist who would improve his soil, by bringing upon it a certain kind of rock or soil, as clay, marl, or lime, of which it may be destitute, as he might go to a valley, not far distant, to obtain it, instead of digging to the bed on his own land. It will be found, likewise, that if the soil is not good on a certain rock, it may be much improved where two different rocks meet, as in the valleys denoted in the cuts; for one may be a cold clay and the other a dry sandy soil, but these, on mixing, mutually modify the properties of each other. Such will be good soils for the growth of turnips, while the addition of a stratum of lime would make it good for wheat.

The divisions of the strata of the earth are then, the *primary*, the oldest and lowest rocks; the *secondary*, the rocks which lie over the last, and the *tertiary*, those which are uppermost and of the most recent formation; the strata of these divisions are sub-divided into groups or *formations*. Some of the last, like the new red sand-stone, afford a soil generally productive, while others, like the coal measures and mill-stone grits, are generally unproductive; but where two soils meet, as with the lime-stone and clay, the soil is generally improved.

The stratified rocks occupy much the largest portion of the earth, and form by far the greatest variety of soils. The unstratified rocks (called also *crystaline* from their having a glossy appearance and crystals within them, and likewise *igneous* rocks because they appear to have been produced by fire,) are of two kinds, *granite* and *trap* rocks. The first consist of a mixture of three minerals known as *quartz*, *felspar*, and *mica*, principally of the two first. Quartz constitutes from one-third to a half of the whole, and forms the substance *silica*, before noticed. When the granite decays it forms the silicious sand of soils. *Felspar*, when it decays, forms a very fine clay. Hills and ridges of mountains are formed of granite. Rains and streams wash out the felspar and carry it off in fine clay, while the quartz-sand remains on the side-hills. The soil, therefore, on the flats and valleys near granite mountains, are generally cold, stiff and wet clays, and that on the side-hills is thin, sandy and barren. Granite rocks most washed, have the light clay much washed out and are therefore most barren.

The trap rocks, consist of the green-stones and basalts, which are composed chiefly of felspar and hornblende. Both of these are reduced by the action of the weather to a powder affording the materials of soils. The principal earthy matter of the granite is felspar. The chemical composition of felspar and hornblende greatly vary in soils, as follows:—

	Felspar.	Hornbl.		Hornblende.
Silica, -	65	42	Magnesia, -	- 14
Alumina, -	18	14	Oxide of Iron, -	- 14½
Pot-ash and soda,	17		Manganese, -	- 1½
Lime, -	-	12		

This difference must effect the soils they produce. A granite soil, besides the silicious sand, consists mostly of silica, alumina and pot-ash; and a hornblende soil consists, in addition to silica, of lime, magnesia, and oxide of iron, in the proportions of 2½ cwt. of each for every ton of the decayed rock. A hornblende soil therefore contains more of the constituents of plants than that of felspar. But these being mixed, as in the greenstones, the soil is still more productive; the felspar supplying the soda and pot-ash, which the hornblende

wants, while the latter supplies the requisite lime and magnesia. Hence, while the granite may be unfruitful, trap soils may be very productive. These soils are however much modified in different countries, by the union of other minerals. Decayed trap is occasionally dug up and successfully applied as top-dressings to granite soils.

It should be remarked in this connection that soil exposed to occasional inundations may be entirely changed thereby; so that whatever may be the rocks below, or in the neighborhood, the sand, clay, etc., brought upon the soil by swelling streams will constitute the soil they cover. This is well known in Egypt and other parts flooded by streams. These streams also convey decayed organic matter, which, with the earthy materials brought from hills and rocks near by, and deposited by them, often produce the most productive soils. It has been by this process, indeed, that most of the horizontal strata have been formed, even to a great depth. Still, in general, the soil may be determined by the underlaying rocks, and especially where soils are not exposed to the floodings alluded to.

The effects of climate on soil is of much importance. Some soils are heavy, as sands and marls, and others are light, as peaty soils, etc. The latter may, of course, be improved by a covering of clay, sand or lime-stone gravel. Strong clay soils retain three times more water than sandy soils; hence the importance of draining the former and also of peaty soils. Plants are often quickly burned up in sandy soils, as they retain moisture but slightly and readily yield what they possess; but, in very rainy weather, they sustain a good vegetation, while plants perish from excessive moisture in clayey soils. Soil shrinks in drying in proportion to their constituents; so that in peaty soils the roots are compressed and the air is excluded, while sandy soils are not contracted by drying. These absorb but little moisture during the night, whilst clayey soils often absorb a 30th part of their own weight, and a dry peat a 12th part. Thus will be seen the importance of a due mixture of the foregoing constituents of soils, under all circumstances.

The importance of temperature on vegetation has been noticed elsewhere, but it will be seen from what has been said that different soils require different degrees of temperature. Some become much hotter than others, so that while the temperature in the shade may be 60 or 70° a dry soil may be 90 or 100.—(*See page* 124). The temperature rises more slowly in wet soils, and these are never so warm as dry soils; hence they are called *cold*. Brown-red soils are heated more than sand, clay, or garden mould, and peat is heated more than any other. The addition of dark vegetable matter renders soils warmer by the effect of the sun, while the color of dark red marl, from old and new red sand-stone, may aid them in their fertility.

The chemical constitution of soils may be further considered in relation to their functions. These, in the mass, are to serve as a base in

which plants may fix their roots and sustain an erect position, also to supply inorganic food to plants at all periods of their growth, and to act as a medium for the chemical changes essential to the preparation of their food. In noticing the constituents of soils, we have omitted to mention *traces* of several others, yet these, in a rigid chemical analysis, are of some importance. Still, as most of our readers are supposed to have but a limited acquaintance with the nature of these constituents, or with the means by which they can be rendered practically useful, it would be of no possible use to go into minute details. But, from what has been said, it will be perceived that some lands are well adapted and others ill-adapted to particular kinds of crops, and that it is of the first importance to perceive and to practice upon these facts.

In our remarks on vegetable geography it will have been seen that particular wild plants, in accordance with their natural habits or preferences, have uniformly selected particular places for their habitations, nor should we be blind to the fact that this is as much in accordance with their choice as it is for animals habitually to select and retain certain places as most agreeable to them and as best affording them the means of life, health and the propagation of their species. Salt-loving plants, as a consequence, select the borders of the sea shore or salt lakes; and thus with most species and genera of plants, as seen in our view of their particular localities. Art may, however, adapt the soil to suit the requirements of particular plants and induce their location and growth, while other plants will not, or cannot be made to thrive on certain soils, any more than animals which are not there accommodated with the means of growth and enjoyment. One kind of grass only will grow on peaty soils; but, if this be limed, green crops will spring up; yet, requiring other elements, they will produce much straw but no fruit. For them to flourish, therefore, the soil must be furnished with other materials. Mare's-tail abounds on the margin of streams; and, if these streams contain much carbonate of lime, water cresses will spring up and flourish along its sides and shallow bed. The red clover and the vetch are delighted in the presence of gypsum, and white clover in alkaline matter, and some heaths will show themselves above serpentine rocks. The alternations of forest trees and of various other plants, for these reasons, we have elsewhere spoken of; and we might enumerate other remarkable instances. These show the chemical constitution of the soil, and that when it is deprived of the constituents essential to the growth of one kind of plants, they will disappear and others will take their place, for the growth of which the soil may be much better fitted. We only follow nature herself, therefore, in rotating crops.

The soil often becomes sick or tired of a certain crop or plant, and thus indicates a change in its chemical composition; but it may

have become the better fitted, nevertheless, for some other kinds of plants. A particular species of plant may and does in time, exhaust the soil of a certain constituent, but another takes up, in preference, some other constituent which the previous one rejected. Hence the crops should be so varied as to take up all the elements furnished by manures, otherwise these, containing various elements, will be of little use to a soil, or to a particular crop, which already finds in the soil an abundance of the elements furnished by the manure. Again the manure may not and very often does not contain the elements which the plant most wants. The tillage of the soil therefore has well been called a branch of practical chemistry.

Supplying the soil with food for plants is manuring it, whether the materials be earthy or saline food, gypsum, nitrate of soda, bone-dust or the produce of the farm yard. Manures are therefore of *vegetable*, *animal* or *mineral* origin. Vegetable manures loosen the soil, make it lighter and yield those organic materials which plants should find in the soil but which exist in the manures peculiarly fitted to enter into the circulation of the plants. But this is to be in accordance with the kind of plants and the parts of which they are composed, and consequently with the quantity and kind of inorganic matter in the different vegetable substances. 100 lbs. of the fermented saw-dust of the willow add to the soil but 4 lbs. of saline or earthy matter, while the same amount of the dried fermented leaves of that tree adds to it 82 lbs. of inorganic matter. Green vegetable matter, having the juice in it, decays most readily, and most readily imparts nourishment to the plant. If mixed with the earth from the bottom of ditches, the compost soon enriches the ground. The same occurs when a green crop is ploughed in. This was much practiced by the Romans. Potato and turnip tops buried in the soil where they are raised, best enrich the soil. Thus buck-wheat and tares are ploughed in when the flower just begins to open, and the land becomes richer thereby than when the seed was sown. Three-fourths of the matter thus buried has been derived from the air and is most equally diffused in the soil. Ammonia and nitric acid are also produced to the greatest extent in this way. Every green vegetable should therefore be buried, instead of being cast away.

Sea weeds are especially valuable for fertilizing the soil. Crops have been trippled by its use. They decompose easily and yield both organic food and saline matter to grass, or green crops. Dry vegetables decay very slowly, straw is therefore mixed with other substances that ferment more readily; other dry vegetables thus ferment, if much divided, such as saw-dust and shavings. The more complete the fermentation, if not carried too far, the more immediate will be its effects. The straw of the grain-plants, or the stems and leaves of grasses are mostly used, but the seeds are much more

riching. These, except those from which oil has been expressed, are however too valuable. Rape seed is thus used in the spring with the greatest advantage.

Charcoal powder has the property of absorbing noxious vapors from the air and soil, and impurities from water; it also imbibes oxygen from the air. This is therefore very valuable to mix with any other kinds of manure; it is also used advantageously alone. Garden seeds sprout in it with great quickness and certainty. *Soot* from coal or wood is also very valuable, used in the same manner. Its immediate effects are attributed to its ammonia, etc. *Peat* likewise supplies a great quantity of inorganic matter. Peat bogs drained, and lime and clay afterwards applied, becomes excellent corn-bearing soil. Peat mixed with ammoniacal liquor, or when half charred and blended with the liquid of the farm-yard, is thought to form the best of compost for plants.

A ton of the several kinds of straw or hay in manures, will return to the soil the following quantities in pounds, respectively, of inorganic matter:—Wheat-straw, from 100 to 360; oat-straw, 100 to 180; hay, 100 to 200; barley-straw, 100 to 120; pea-straw, 100; bean-straw, 60 to 80; rye-straw, from 50 to 70; dry potato tops, 100; dry turnip tops, 260; and rape-cake, 120. The effect of these on particular plants is not however always in exact proportion to the absolute quantity. If the fertilizing value of these is to be estimated by the quantity of nitrogen they contain, as some suppose, the following would be the proportion, in pounds, of some of the best:—Fir or pine saw-dust, 250; oak ditto, 180; barley straw, 180; wheat ditto, 80 to 170; oat straw, 150; farm-yard, 100; buckwheat, 85; green grass, 80; fresh sea-weed, 80; potato tops, 75.

It is said that 80 lbs. of meadow-grass ploughed in is equal to 100 of farm manure. The application of carbon to plants must be important, since it is believed that each element in decaying plants is capable of affording food to the living plant.

Animal substances used for fertilizing the soil are mostly the flesh, blood, bones and hair of animals, and the bodies of fish, with the solid and liquid matters of animals and birds. These act more powerfully than vegetable substances, seeds excepted. Flesh is not much used. Fish, in this country, are applied quite extensively in some parts, and are very efficacious, though on ordinary soils, they are quite too strong when applied directly to it. They should be made into compost with large proportions of earth. 5 barrels of fish to 20 loads of compost is ample for an acre. The refuse of skins boiled for glue, fish oils, and of the dried fat of animals, hair, woollen rags, etc., when made into compost, is much more effectual than vegetable substances. Insects are used in large quantities in parts of Europe. Blood makes an excellent compost, but it is little used. As used by the Sugar

Refiners, with the lime and charcoal, blood is much and effectually employed in France. This is animal black, or animalized charcoal, containing 20 per cent. of blood, and is sold for more than the blood and charcoal originally cost. Artificial mixtures of charcoal, blood and other matters are, accordingly, now manufactured extensively. The efficacy of horn, wool, or hair, depend on the same elements as other animal matters. These are, however, dry, while blood and flesh contain 80 or 90 per cent. of water; thus they should improve the soil 6 or 8 times as much as the same weight of blood. But the effect of the latter is more immediate, while that of the former, they being dry and hard, is slowly perceived. *Bones* contain both animal matter and a large amount of earthy matter. 100 lbs. of the bones of the cow, for example, consist of 55½ lbs. of *phosphate of lime*, 3 of *phosphate of Magnesia*, 3½ of *soda* and *common salt*, 33¼ of *carbonate of lime*, 1 *fluoride of calcium* and 33¼ of *gelatin* or the same substance as horn. The *organic* matter in 100 pounds of bone (gelatin) is no more than in 33 pounds of horn, or as 3 to 4 of flesh or blood; yet they supply a large amount of inorganic matter, and the kinds most wanted for good soils, as seen above. Animal substances containing much water, as with flesh and blood, decay rapidly, and operate immediately and powerfully; but those which are dry, as horn, wool and hair, decompose and act slowly, and last perhaps for several seasons; while bone, like horn, may act for several years, as they are very productive of earthy matter.

Digested animal substances are the liquid and solid excrement of domestic animals. The former act mostly through the saline substances they hold in solution, and they act speedily, while the latter contains also insoluble matters which decay slowly. Human urine contains, in 1000 parts, *water* 932, *urea* and other organic matter containing nitrogen, 49; lime, phosphate of ammonia, soda and magnesia, 6; sulphate of soda and ammonia 7; salamoniac and common salt 6. In these there are 68 lbs. of dry fertilizing matter of the most valuable quality, which Johnson estimates to be worth, at the price artificial manures are sold for in England, at near $4, 50 a cwt.; so if a person voids 1000 lbs. a year, which is the estimate, the waste is calculated at about $2 50 each. If, therefore, 5 tons of manure are required for the acre, and if 4 cwt. of the solid parts of urine produce the same effect, that of 10,000 persons would supply 15,000 acres, yielding 36,000 bushels of grain-corn, or an equal product of other crops. It is estimated also, that the liquids and solids of the cow is worth from 10 to 20 dollars; so that a practical agriculturist may readily calculate the loss in this way. Before sprinkling the liquid upon plants or the soil, it should commence fermentation and be united with a quantity of water. To obtain the valuable properties of the liquid, burned gypsum is mixed with it in the proportion of 10 lbs. to 7 gals.,

occasionally stirring it and drying and pulverizing the gypsum. This is sold in England as *urate;* but it is less valuable, as it does not contain the soluble saline matter. But, of all substances for fertilizing the soil, night-soil is the most valuable, especially when dry, as poudrette.

Animalized charcoal is now much manufactured by blending the above with gypsum and ordinary wood charcoal in fine powder. Charred peat also, mixed with it would be equally valuable. Eminently fertilizing powers are likewise possessed by the deposit of all birds. Of guano we have already spoken; this is now sold in England, as imported, for $4. 50 per cwt. The newly discovered process of preparing the seed, as alluded to in a previous article, may when disclosed, be of the greatest importance. And it appears to us reasonable to suppose that such, or some other important preparation of the seed, may readily be effected; for it is obviously the most simple, natural and effective mode of imbuing the plant with nutritive principles. To return to the soil or to the plant, the elements of which the latter is composed, is evidently the object of all the applications referred to; and the above last-mentioned substances are clearly those best calculated for this purpose.

The amount of nitrogen which any one of these contains is said to be the readiest and most simple criterion by which their agricultural value, compared with vegetable matters, can be estimated. Thus the relative proportions of this element, as compared with 100 lbs. of farm-yard manure, is, with a few of the more important, as follows: dry woollen rags 2½, horn shavings 3, cow hair 3, feathers 3, dry flesh 3, manure of pigeons 5, liquid blood 15, and the various liquids and solids of cattle from 16 up to 100. So 2½ lbs. of woollen rags is equal, in the nitrogen or organic matter it contains, to the 100 lbs. of farm-yard manure. Still it will be seen that some of these and other materials, contain more saline matter than the dry substances classed as first in their quantity of nitrogen. But no one simple substance can answer for a long time on the same soil; and hence the necessity, under all circumstances, of using mixed manures and artificial composts. The principal difference between animal and vegetable substances, will be seen to consist in the greater amount of nitrogen contained in the former. These are also distinguished, generally, by the rapidity with which they decay when moist. Their nitrogen gradually assumes the form of ammonia, as perceived by the smell; but the escape of this should always be prevented, it being the most valuable property of the substances.

The source of nitrogen supplied by the animal body may be perceived by the facts that, whilst we receive in our food much nitrogen, little or none is given off in life in the usual forms. If a man eat, say 1½ lbs. of bread and 1 lb. of meat in 24 hours, he gives off 8 oz.

of carbon in the same time. He has received, then, of carbon 4,500 grains, and of nitrogen 500 grains, while he has given off in respiration 3,500 grains, but very little or no nitrogen. Hence there is left to be converted into the body, or to be rejected, 1000 grains of carbon and 500 grains of nitrogen. Vegetable food is freed of much of its carbon by expiration; its nitrogen, of course, mostly remaining. In the food above mentioned the carbon was to the nitrogen as 9 to 1, and after the expiration of the carbon, it is in the proportion of 2 to 1. This residue of nitrogen, or so much of it as is not carried off in perspiration or voided, is incorporated with the body; and, although this is proportionably very small, it ultimately constitutes a considerable portion of the body. It is contained principally in the blood, muscles, tendons, and the gelatinous parts of the bones, and is most abundant, in young persons, or animals, and therefore less escapes from the body of such than from older ones.

Mineral waters applied to plants afford many of the important salts we have before spoken of. Nitrates of soda and of pot-ash impart to the leaves a rich dark green color, and hence they are advantageously applied to grass and young grains, in the proportion of 1 to 1½ cwt. per acre. The nitric acid contained in them affords the nitrogen; and the soda and pot-ash also serve important purposes, as we have seen by the analysis of plants. For clovers, grasses, and other green crops, sulphate of soda is recommended; and, mixed with nitrate of soda, it is remarkably productive on crops of potatoes. Sulphate of magnesia may also be applied with equal success to the grains and grasses. This may be obtained from our alum works at a nominal price. Sulphate of lime, or common gypsum, is applied extensively in this country to grass land, and indeed to those of almost every kind of crop. But it should be ascertained, before this is applied, if the soil does not contain within itself the salt or salts applied; for lime is often used without beneficial results, and therefore thrown away on soils already containing it. *Common Salt* on very many soils is undoubtedly highly fertilizing and essential to the healthy condition of many crops, especially on inlands and highlands much washed by rains.

Kelp, or the ash left by burning sea-weed is valuable. It contains pot-ash, soda, sulphur, silica and chlorine, with other inorganic matter required for the food of plants. Sea-weed, partly charred, is thus used with much success. The common pearl-ash, though in an impure state, with sulphate and silicate of pot-ash, all contained in common *wood ashes*, show that this is often very successfully applied to soils.

Lime, it is well known, is extensively used in practical agriculture, and has been from the earliest period. All the varieties of its forms, as *lime-stones*, *shells*, *chalk*, *etc.*, are composed of carbonic acid and lime, and hence is carbonate of lime. But when submitted to heat

the carbonic acid is driven off and the lime remains. This is called *quick lime*, which, when exposed to the air, ultimately falls into powder, by absorbing carbonic acid from the air and forming thereby carbonate of lime again; or, when water is thrown upon it, swells and becomes one-third heavier by the combination with it of the oxygen of the water, and giving off the hydrogen with the latent heat of the water which before kept it in a fluid state. Lime is used in a *mild state*, as a *carbonate*, in marls, chalk, powdered shells, etc.; or in a caustic or quick state, as it comes from the burning or after being slacked. Marl contains from 5 to 20 per cent. of carbonate of lime in the state of a fine powder. Shell-sand, found on the shores, contains also from 20 to 50 per cent. of silicious sand. Some lime-stones also contain considerable magnesia, and hence are called *magnesian lime-stones*. Most lime-stones contain some magnesia which is useful for plants, but if above 10 per cent. it is thought to be deleterious. The quantity of lime used in dressing and the frequency of its use should depend on the depth of the soil and the mode of culture. A large or more frequent application is necessary if the soil be wet, but when it is thin and dry a moderate coat will penetrate to the depth of 8 or 10 inches, or the ordinary extent of ploughing. A thinner dressing still is requisite on old pasture lands, the grasses living in 2 or 3 inches of soil. But in reclaiming lands, or laying them down to grass, a heavy dressing is often necessary; and in ordinary arable culture considerable quantities are used because the soil is deeper on stiff clay soils after draining, and where there is much vegetable matter much lime may be profitably added.

The chemical constitution of soils is not materially affected by the use of lime. All soils contain naturally more or less. 300 bushels applied to the acre seldom amounts to 1 per cent. by weight, of a soil 12 inches deep, when well mixed. If thinner, the per cent. will be in proportion. The effects of lime are seen gradually to diminish, so that in a few years, on analyzing the soil, it has entirely disappeared; hence the importance of occasional lime at least. Rains, charged with carbonic acid by the air, dissolve the carbonate of lime, and remove much of the lime. Other portions of it are dissolved by the formation of acids in the soil, and it is therefore readily removed by rains. The first action of quick lime on the soil is to combine with all the acid matter, by which the soil may be said to be sweetened; and some of the liquid compounds it thus forms, enter the roots as the food of the plant. Portions also decompose saline compounds of iron, alumina, manganese, pot-ash or soda, found in the soil, part of which are the food of plants. The organic matter of the soil likewise undergoes a more ready decomposition by which many compounds are formed highly important in vegetation. By being soluble in cold water, this matter is readily diffused through the soil, and when reconverted

into carbonate, it has the advantage of being in a much finer state than when ground and first applied. It promotes, during the decay of organic matter, the formation of nitric acid, which is very influential in vegetation, forming with it *nitrate of lime*. This salt is very soluble in water and therefore enters readily into the roots of plants, producing the same effects upon them as the nitrate of soda.

Irrigation of the soil is another mode of improving or manuring it. This is extensively practised in South America and the East, though for no other purpose generally than to moisten a dry soil. But in more northern climates, it washes out the acid and other noxious matters generated in the soil. Its favorable effects are seen in peat soils, which contain much matter unfavorable to vegetation, and in subsequent drainings. The deposits also of productive organic and inorganic matter in the form of mud, in addition to the soluble matter, proves generally of great advantage to plants. They absorb from the water the salts which, as we have noticed, are so valuable in their growth. Draining and burning of pure soils is also much practised. When the vegetable matter of the sod is burned the ash of the plants is left to blend with the calcined earth. The ash supplies the soil, like dressings, with inorganic matter, and the carbonaceous matter at the same time contributes to correct and improve the soil. The advantages of burned clay are not that it contains any organic matter useful as the food of plants, but that it will crumble into a friable powder; and instead of a paste-like substance, it becomes comminuted and equally diffused, so as to give a due consistency to the soil. Thus it will render even clay soils more open and modify the texture of most others, not chemically but mechanically. Burned bricks render soils more porous, and are supposed to imbibe and condense air, which facilitates the decay of vegetable matter and aids the early growth of plants. They are thus believed to imbibe ammonia and nitric acid from the air. Charcoal has a similar effect, though the entire operation of this as well as of burned clay, is to be further and better understood by repeated experiments.

The productive powers of soils are mostly modified by the plants grown on them. Lands unfit for arable culture, may be made to produce profitable arable crops by the continued growth of wood. But there is a difference in the kind of trees thus calculated to improve the soil. The pines may not improve it at all, and the beech and sycamore may render it even less valuable than at first. Oaks render it better only after 15 or 18 years. The larch renders it still better, though in a still longer time. This improvement is the result of additions to the soil by the leaves of the trees. But the green foliage delays the decomposition of the fallen leaves by shading them from the favorable influence of the sun. Some leaves decay more readily however than others—the beech and oak, for example, sooner than

the pines. Those of the oak contain 5 per cent. of saline and earthy matter, while the fir tribe afford only about 2. The improvement, therefore, is in proportion to the quantity and kind of inorganic matter trees receive from the air. This determines also the kind of grasses which will be produced. Lands laid down with artificial grasses for a few years are better fitted for grain crops; but they deteriorate after this time, it is believed, if kept in these grasses. They will not improve beyond a certain extent, any more than they will with any other crops. Old and extensive commons, heaths and wastes are evidences in point. But some grass-lands retain their good condition for a long period without manuring, as some rich grain-lands have for a century. Any improvement that takes place is in the formation of a dark-brown surface-soil, imbued with vegetable matter, and which becomes thicker in proportion to the time it has laid down to grass. The thickening however sooner ceases if the soil be light and sandy; if moderately heavy, the improvement continues longer, and if somewhat clayey, it may be made permanently good.

The analysis of the best pasture lands shows that they contain from 8 to 12 per cent. of organic matter, mostly vegetable; from 5 to 10 of alumina, and from 1 to 6 of lime. If but a 10th part of the grass dies annually on the soil, in the state of roots and stubble, vegetable matter must increase, in time, to a very considerable amount, while arable land cannot be improved from this circumstance, as it is constantly turned up with the vegetable remains. The leaves and roots of the grasses contain inorganic and saline matter; and dry hay, when burned, yields 8 or 10 per cent. of its weight of ash, so that, beside the vegetables left in the soil, a fine earthy powder is formed, which is the cause of the fineness of the surface of old grass fields, consisting mostly of lime and silica, and differing from the clay soil originally and now below. Clay soil is also modified by the roots of grasses penetrating it, and opening a way for the rains, which carry down the clay with them. Thus changes in the character of soils constantly take place. Soils which are light contain little clay, and the grasses therefore thrive more rapidly, and a thicker sward is sooner formed; but the rains wash out the clay and they do not form permanent pasture lands, as with clay soils. If the old pasture lands are ploughed up, many years will be required to effect the same condition as that before, as the lower soil is mixed up with the fine mould of the surface, and the vegetable matter disappears by rapid decomposition. At first the sowing down of natural grasses on heavy land will often disappoint expectations; and on light and loamy lands, a thick sward cannot well be expected; but in time both soils may be improved.

The quality and quantity of grain depend upon the means adopted to improve the soil. Flour made into dough and washed with water on a linen cloth, as long as the water passes the milky flour through,

is converted into starch, which settles in the water and the gluten remains. This gluten, and hence its nutritive properties, varies with every portion of flour thus used. The grains therefore, yielding the largest portions of gluten, afford the most flour and the greatest weight of bread. Thus the weight of gluten in 100 lbs. of dry wheat varies from 8 to 34 lbs., in accordance, generally, with the kind of manure used on the soil. The proportions of starch and gluten in 100 lbs. of grain on the same soil, differently manured, is from 66 to 41 of starch, and from 10 to 34 of gluten. Blood yields 41 lbs. of starch and 34 lbs. of gluten, while vegetable manure yields 66 lbs. of starch and 10 lbs. of gluten; and other substances yield intermediate proportions of both. Potato-flour, which is composed almost entirely of starch, makes a fine and easily raised bread; and wheaten flour, containing little gluten, comes next in lightness. The greater the quantity of gluten the greater the care necessary to produce light bread, though always more nutritive.

The time of gathering crops determines also the amount of their nutriment. Thus, radishes left too long in the ground become hard and woody, and so with the stem of the young cabbage and the artichoke; and so it is, in effect, with the grasses cut for hay. There is much sugar in these, and as they grow up, this is changed into starch, first, and then into woody fibre. Therefore, the riper the plants becomes the less sugar and starch they contain, in proportion to size. Those parts of a plant which dissolve most easily are the most nourishing: starch and sugar are readily soluble in water. The weight of cut straw or hay is less when perfectly ripe. These should be cut, consequently, soon after they are at their greatest weight, when both the quantity is greatest and the quality is best, and the same may be said of all the corn or grain crops. The straw commonly begins to diminish three weeks previous to being fully ripe, and it becomes less nourishing after that time. But the ear of grains which is sweet and milky four weeks before it is ripe, afterwards becomes consolidated, the sugar changes into starch, the milk thickens into gluten and the albumen of the flour. And when this is completed, two weeks before the ripening, the grains contain the greatest amount of starch and gluten. If grains be cut at this time, they are heavier, and they will yield the greatest amount of good flour and the least bran, as the skin of the grains are always thinest at this time. If, however, they are left longer, the grains cover themselves with a thicker skin for protection, a part of the starch is also changed into woody fibre, as in the ripening of hay, the radish, etc. All corns or grains should therefore be cut two weeks before ripening.

The quantity of food afforded by an acre of land depends on the kind of crop. Little gum or sugar is present when seeds are fully ripe, their nutritive properties depending on the amount of their starch

and gluten. But in bulbous roots, as potatoes and turnips, the sugar and gum are retained, and these constitute their nutritive ingredients. To estimate the relative weight of dry starch, gluten, gum and sugar, in each crop of *an acre*, this table will be useful;—

Crop.	Bushels.	lbs.	Starch.	Gluten & Albumen.	Gum & Sugar.
Wheat	30	1,800,	990	378	71
Indian corn	60	3,120,	2,100	280	90
Potatoes	10 tons	22,400,	2,688	240	woody fibre.
Oats	50 bush.	2,250,	1,215	100	250
Barley	38 "	2,000,	1,200	120	160
Peas	15 "	1,000,	420	260	20
Beans	25 "	1,600,	670	370	
Turnips	25 "	5,600,	3,090	1,400	5,000

It may be inferred that, if the amount per acre be a fair average, wheat land would raise 10 tons of potatoes, or 1,698 lbs. more of starch; with Indian corn it would raise 1,110 lbs. more starch, and with turnips 2,100 lbs. more. If the acre of wheat then will support one more—so far as the nutritive properties of the crops depend on the starch and sugar—the same planted with oats and barley will support one and a-half, with Indian corn three, or with turnips five. If the relative quantities of the gluten be compared, wheat, Indian corn and beans, yield about an equal quantity, and potatoes one-third less; but turnips yield four times as much gluten as any one of the three. Hence the turnips having 3,090 lbs. of starch and 1,400 lbs. of gluten, are the most nutritive crop that can be raised, especially for fattening cattle. And were its nutritive qualities more agreeable for consumption by man, it would support by far the largest population. The pea and bean will be seen also to be much more nourishing, so far as the gluten they contain is concerned, and according to their relative weight, than wheat or any of the other crops; 56 lbs. of beans affording as much nutriment as 67 of peas, 100 of wheat flour or 177 of rice.

Vegetable food is capable, not only of supporting man and animals, but also of fattening them; hence living vegetables must be furnished with all the substances necessary to enter into and build up the parts of animal bodies, and to supply the waste of life. It must have carbon in the first place for respiration. The consumption of this in an adult, with little bodily exercise, it is said, is about 5 or 6 oz. per 24 hours; with one taking ordinary exercise, about 8 or 9 oz., and with one having great exercise, from 12 to 15. If the mean quantity be taken, say 8 oz., then a man must consume daily, 18 oz. of sugar or starch. If this be in the form of bread, 1¼ lbs. will be required, if in the form of potatoes, about 7½ lbs., in the raw state. For a sedentary person 5 lbs. of potatoes may suffice, but for one with continued or violent exercise, 12 or 15 lbs. are necessary. This, it will be un-

derstood, is for the supply of requisite carbon only; and if the food be less, the carbon will be proportionably diminished. The food must also supply the waste of the muscular part of the body, which in a body full-grown, is daily abstracted by other natural processes. The flesh or muscular parts of animals are colored by blood, but if these be well washed they become white, and are found to be composed of fibrin, a white fibrous substance. The blood consists chiefly of the same substance, and the skin, horn, hair, bones, etc., are composed mostly of gelatin, like glue, and analogous to fibrin, albumen (like the white of an egg,) the curd of milk and the gluten of flour. All these consist of four ultimate principles and in nearly the following proportions:—carbon 55, oxygen 20, nitrogen 18, and hydrogen 7, in the 100 parts. Sulphur, phosphorus, etc., are also constituents. The amount of these removed by perspiration, excretions, etc., in 24 hours is about 5 oz., having about 350 grains of nitrogen. These are then to be made up by the gluten of the food. After supplying the carbon of respiration by the 1¾ lbs. of wheat, there is about 3 oz. of gluten left. If 2 oz. of beef be added, containing a proportion of fibrin, there then will be—

Of the 1¾ lbs. of bread starch,	18 oz.	- Gluten, -	3 oz.
And of 8 oz. of beef, - -		- Fibrin, -	2
			5 oz.

Consumed for respiration and other waste.	Consumed for waste of muscles, &c.

The 7½ lbs. of potatoes contain about 2½ oz. of gluten or albumen; so that to supply 5 oz. of these substances, beef, eggs, or other animal matter may be eaten. Thus a diet for the preservation of human strength, is easily made up of vegetable and animal food, jointly; for, to supply this waste and the necessary nitrogen, in the form of gluten, with vegetable food alone, it is obvious that a much larger portion must be consumed. Of wheat-bread alone, 3 lbs. is necessary to supply the requisite nitrogen, calculating wheat-flour to contain 15 per cent. of gluten. This would leave a superabundance of carbon in the starch, with which the stomach might be burthened if not readily voided. The requisite nutriment may be better supplied, it is thought by 1¾ lbs. of bread, and 4 oz. of cheese.

To impart the same amount of gluten, 4 lbs. of rice would be necessary for a man daily. Graminivorous animals are provided with larger stomachs than man, hence vegetable diet is better suited for them, yet a little oil-cake, in which nitrogen abounds, will fatten them more readily than almost any quantity of other vegetable food. The human body, beside the substances we have named, contains much saline matter in the form of sulphates, muriates, phosphates, compounds of potash, magnesia, soda, lime, etc., portions of which daily escape from the body in perspiration, excretion, etc., and all of which are to be

replenished. Under these circumstances, it is a bountiful provision of nature that plants require for their growth the constituents of the animal body, and readily yield them to it for its existence and growth. They thus unite together in a natural, beautiful and inseparable bond, the animal and mineral kingdoms, and each with themselves in all their parts and functions, blend together the three universal kingdoms in one grand harmonious whole.

Vegetable food supplies the solid bones of animals in the same manner as other parts These are composed of phosphate of lime, in the proportions of 70 per cent. in the sheep, 67 in the horse, and 55 in the cow. A portion of this is also daily rejected from the animal system, which requires to be replenished; and, for this purpose, the gluten of plants is admirably adapted, as well also as the fibre of animal muscle, the curd of milk, etc.; so that the nitrogen and bone-earth are freely abstracted by those living on vegetable food, by the young living on milk or by others feeding on flesh. The sugar of milk supplies the necessary quantity of carbon for the young, and the curd, the materials for the muscles and animal parts of the bones.

These elements, by weight, in 1000 parts of the cow's milk, for example, are—butter 27 to 35, cheesy matter 45 to 90, milk-sugar 36 to 50, chloride of potassium and sodium 1½ to 10, phosphate of lime 2½ to 10, other salts 6, and water 815 to 882. These vary with every condition of the animal, with its food, breed, the weather, etc. Ten gallons contain 4½ lbs. of *casein*, or cheesy matter, which is said to be equal to the formation of 18 lbs. of muscle and 3½ lbs. of bone-earth, or 7 oz. of dry bone. The casein also supplies the skin, horn, hoof, etc., with their portions of bone-earth. The milk contains more butter in warm weather and more cheese and sugar in cold weather. The amount of solid matter thus furnished from the milk is large. If a cow affords 3,000 quarts per annum, every 10 gallons contain bone sufficient to form 7 oz. of dry bone; thus depriving the cow of 33 lbs. of dry bone, which must be supplied from the soil. If this be exported in milk or butter, the soil is drained of bone to the amount of 30 lbs., which would not be the case if it were consumed on the spot. In time this will produce an obvious effect on a particular place or country. It will appear plain, from what has been said, that attempts to supply the wastes of animal life by any one substance, sugar or starch for example, is futile. Carbon might be furnished, but not all the nitrogen, saline and earthy materials essential to animal composition and growth. Gelatin, too, might supply carbon with a portion of nitrogen, but not the necessary saline matter.

The relative amount of nutriment in different substances, taking hay for instance as a standard, may be thus stated.—The proportions of nutriment in pounds equal to 10 lbs. of hay:—clover-hay 8 to 10, green clover 45 to 50, wheat-straw 40 to 50, barley-straw 20 to 40,

oat-straw 20 to 40, potatoes 20, pea-straw 10 to 15, old potatoes 40, carrots 25 to 35, turnips 50, cabbage 20 to 30, peas and beans 3 to 5, wheat 5 to 6, barley 5 to 6, oats 4 to 7, Indian corn 5, and oil-cake 2 to 4. Thus 6 lbs. of oil-cake will nourish an animal as much as 40 lbs. of potatoes, and 10 pounds of oats as much as 20 lbs. of hay. It is an important consideration, that in rich natural pastures there is a mixed herbage, consisting of different plants, some abounding more in starch or sugar, others more in gluten or albumen, and others more in earthy or saline matter. The digestive organs select from these such elements as are most required, and reject any surplus. Hence on pastures occupied by one or two particular grasses, animals will not thrive; or, if they do, they must necessarily consume large quantities to supply *all* the parts. Whenever, indeed, animals are fed on *one* kind of vegetable only, there is a lack of the requisite elements of animal composition; so that a due mixture of the important constituents of food being practised by nature, she should be copied by man.

ELEMENTS AND PROPERTIES OF VEGETABLE FOOD.

A consideration of the nature, constituents and physiological effects of vegetable food very naturally follows what has been said of the organs, physiology, character, habits and location of plants in their living state. The importance of plants to man, and all the graminivorous animals depending alone on the vegetable kingdom for subsistence, and the human family depending in turn on them for essential elements of food, will readily be seen to present, in this connection, the most interesting view of the vegetable kingdom. It is, indeed, for the nourishment and very existence of man, and lower animals, that plants are cultivated; in doing which the great body of mankind are employed, and in which plants assume their chief interest. The relative amount and qualities of the food which plants thus afford, constitute their relative value; and their properties and physiological effects in the animal economy should give to this branch of our subject deeper interest than any other. It is, in fact, the final result or resolution of every other into one, and an exposition of their ultimate utility, composition and properties. In considering this concluding view of plants and their relations to mankind, we shall be brief, as heretofore, however extensively the subject deserves to be or has been treated by others. Our object is to embody the most important truths known and recorded in this department of our subject, without the ambition to start new theories or controvert those established by the experiments and conclusions of others.

All compound substances are composed of a greater or less number of *simple or ultimate elements*. Of these there are 56; some of which, variously combined, are the *alimentary constituents* of all food. Thus composed, they form the proximate principles, in various proportions, of all plants. All vegetable food, therefore, is resolvable into its proximate or alimentary principles; and these in turn, by analysis, are divisible into simple or undecompounded elements. Thus wheat is composed of fibrine, gelatine, albumen, &c., and these are composed of the chemical elements carbon, hydrogen, oxygen, &c. 19 or 20 only of the simple elements have been found in organized, or animal and vegetable bodies. The elements, therefore, of animal or vegetable bodies must be the constituents of their food. As 13 of these enter into the composition of the human body, our food must be composed of the same number and kind of elements. These are carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur, iron, chlorine, calcium, sodium, magnesia, potassium, and fluorine. Other substances become incidentally component parts of organized bodies, such as gold and

some other metals, in vegetables and lead, copper, etc. in animals and man. Silica and alumina are also found in organized bodies. The latter is much eaten, indeed, by some people of the east and of South America. Vegetable charcoal is composed of charcoal, volatile matter and calcined ashes, in somewhat different proportions, according to the nature of vegetables; but of this, as a product, we have already spoken.

Carbon is a prominent and necessary element in all living bodies, and consequently of all food. It is an important and chief constituent of the embryo and food of plants and animals. It averages about 40 per cent. of the chief vegetable alimentary substances, and of some fats and oils as high as 79 per cent. It is consumed in different proportions according to the circumstances of persons. An adult with moderate exercise consumes daily about 15 oz. adv. This is given out by the lungs and the skin in the form of carbonic acid. It is therefore assumed that 6 grs. of carbon combine with 16 grs. of oxygen to form 22 grs. of carbonic acid.

Exclusive vegetable diet has long and strongly been maintained, but it may not be out of place here to say that neither an exclusive vegetable nor animal food is to be recommended, as it is beyond reasonable doubt that the organization of man is calculated and evidently designed for both. The 12 canine and lesser mollar teeth correspond to those of the carnivora, while the 20 incissor and larger molar teeth correspond to those of the herbivora; it is therefore certain that our organs of mastication are intermediate between these two classes of animals. This is equally apparent in the organs of digestion and the length of the alimentary canal, by which man is fitted for, and obviously designed to inhabit any part of the earth. But although thus organized, it is certain that both kinds are not indispensable to health and growth. Vegetable food cannot be obtained in cold northern regions, nor is animal food much required or desired in tropical climates. It is, therefore, apparent that man, in the temperate regions particularly, is emphatically omnivorous. It happens, too, that a due proportion of both animal and vegetable life there exists. But was man from infancy to be confined in this climate to either animal or vegetable food, all his mental and physical powers would undoubtedly be fully developed; nevertheless, if a mixed diet should be abstained from at an intermediate period of life, and animal or vegetable diet exclusively adhered to, neither nutrition nor organic developement will be complete. Innumerable facts and experiments, and the most rational deductions prove this; so that man by nature, habit and circumstances, is omnivorous.

The quantity of oxygen consumed, and of carbonic acid produced, by an adult male in respiration during 24 hours is, of oxygen consumed, not far from 45,405 cubic inches, or 15,751 grs.; but about 5000 inches of this is employed in oxydating other matter. Much depends, however,

on the quantity and quality of the food, the state of the system, &c. Something less than this is the probable average. It is also thought that the skin effects changes of the air not unlike those produced by the lungs.

The combination of carbon with oxygen thus, or in any way effected in the system, evolves heat. Thus a pound of pure charcoal, by combination with oxygen gas, evolves heat sufficient to elevate the temperature of 78 pounds of water from 32° to 212° Fahr. This, then, is supposed to be the source of animal heat, indispensable to the vital process. The conversion of sugar or starch into fat, supplies the system with oxygen, and heat is developed by the union of this with carbon, as with the bile, &c. Whilst the animal system is in a healthy condition, the necessary carbon for the supply of heat is furnished by the food, but otherwise and without food, the fat of the body is consumed by its carbon being converted into carbonic acid and its hydrogen into water.

Diseases of the liver, so frequent in hot seasons and climates, is ascribed by Liebig to an accumulation of carbon in the body. Hepatic diseases arising from an excess of carbon, are prevalent in summer, while in winter pulmonary diseases are frequent, in consequence of an excess of oxygen. The system requires less carbonaceous food and less in quantity in warm than in cold weather; and hepatic diseases among people from the north, residents of tropical climates, is attributed to the use of food fitted only for their former residence and climate. The size of the liver is thought to be inversely in proportion to that of the respiratory organs. Carbonic acid is evolved in proportion to the temperature, the lungs being inefficient when the air is much rarified; consequently the liver must excrete more carbon to preserve the blood from carbonaceous matter; and a greater secretion of bile is required in hot climates to compensate for the lesser action of the lungs in purifying the blood. Less carbonic acid is evolved by persons living on vegetable diet than when living on animal food.

The heat of the blood being the same in all climates and conditions, a larger portion of combustible materials is required to preserve the necessary temperature in cold than in warm weather, because more heat is given off to surrounding objects, having less of it; consequently more food is required. It is, indeed, generally known that a person well supplied with nutritive food in cold weather sustains the cold much better than one sparingly supplied, and that a person will die much sooner without food in cold than in warm weather. Hence the enormous quantity of food consumed by people in very cold latitudes, and the small quantities consumed by those in very warm climates. The customary food also of the first is seen to be chiefly fats and oils, containing from 66 to 79 per cent. of carbon, while that of the latter (the Hindoos for example) is a light vegetable food. An

Esquimaux eats, says Capt. Ross, 20 pounds of flesh daily, and Capt. Cochrane says he has repeatedly seen a Yakuti eat 40 pounds of meat a day; and a Russian Admiral was informed that one of them consumed in 24 hours the hind quarter of a large ox, 24 pounds of fat, and a proportionable quantity of melted butter as drink. To test this, the Admiral gave him a thick porridge of rice, boiled with 3 pounds of butter, the whole weighing 28 pounds, which he consumed on the spot; and this, too, after he had breakfasted.

The natives of Greenland cannot subsist without large quantities of fats and oils; but this, undoubtedly, is in part an instinctive propensity, and not wholly the result of climate, as some in warm climates are little less voracious. Dr. Pereira justly ascribes this fondness for food to an original propensity. It is certainly everywhere well known that some persons are what are called *great eaters*, while others are small eaters. This fact is observable in the people of different nations. The Spanish and French are very moderate eaters, while the Germans, English and Americans are great feeders. The organ of this faculty, Dr. Vimont observed to be remarkably distinguished among a large collection of men of those nations. This, of course, usually corresponds with the accustomed exercise of the propensity, as the result of necessity.

In the above example, the Doctor saw that the Spanish and French were satisfied with some fruit, a light soup and a little meat, while the Germans constantly complained of the want of meat, and continually assailed him with the cry of "flesh, flesh, sir."

The organ of *alimentiveness*, the function of which is an *appetite for food*, is considered as established by some of the most distinguished medical men, both as to its office and location. It is as apparent that the instinct of nutrition must have physical powers for its manifestations as that any function of the body or mind must have an appropriate organ. Nor is it less true that each function of mind must have a distinct and fit instrument for its exercise, than that all must have such an instrument as the brain or the whole body for the manifestation of the whole or any class of the phenomena of life. Strange inconsistency that which would make the brain an exception to all the laws of organic nature! Mr. Combe says "the stomach is to this organ what the eye is to the sense of seeing. Cut off the communication between it and the brain, and the appetite will be lost. A dog was kept without food till he was ravenous with hunger; the phneumogastric nerve was then divided and the sensation left him at once. Examples in the crania of mankind are remarkable."

Hydrogen is an essential element of the body and a necessary ingredient of vegetable and animal food. The proportion in which this is found varies in different alimentary substances. In one class it is in the proportion to form water with oxygen, in another it is in a greater

proportion, or in excess, and in another it is in a less proportion than in water.

The first class of alimentary principles in which these two elements are in the same ratio as in water, are called *hydrates of carbon*, consisting of carbon and the two elements of water, hydrogen and oxygen, as with starch, sugar, gum, vinegar, &c. These, therefore, afford carbon for oxydation in the system, while the hydrogen remains united with the oxygen in the water. Gramnivorous animals expire a volume of carbonic acid equal to that of the oxygen they inspire; hence there is no loss of oxygen. A large proportion of the food of these animals consists of principles containing hydrogen in the proportion of water, or at the point of its saturation with oxygen. The affinity of hydrogen at the temperature of the body is greater than for carbon, hence a volume of carbonic acid is expired corresponding with that inspired, as little hydrogen is afforded to combine with the oxygen.

The second class or group of principles, in which hydrogen is in excess, includes nitrogenized and non-nitrogenized food. These principles are lard, alcohol, protein, albumen, fibrine, &c. These constituents of food are ultimately changed in the system by the conversion of their carbon into carbonic acid, and the hydrogen into water. The hydrogen of food unassimilated with the unoxydized carbon is expelled in urine and the fœces. The union of hydrogen and oxygen causes the evolution of heat; and in the combustion of equal weights of hydrogen and oxygen the former gives out more heat than the latter.

The third class or group contains hydrogen in a less proportion than in water, as in pectine, or vegetable jelly, and some vegetable acids; their hydrogen is therefore combined with carbon and oxygen.

Oxygen. This is the most important element of food and of organized beings, and is said to constitute 3-4ths of the solid globe. It constitutes 23-100ths, by weight of the atmosphere, and 8-9ths, by weight of the water and mineral portion of the world, and 16-22ds of the carbonic acid of the atmosphere. The three most abundant constituents of the earth, silica, carbonate of lime and alumina, are composed of about 45 per cent. of oxygen. It is the most active agent in all natural phenomena; and without its ceaseless influence, all life would cease. It is an essential element of food, such as starch, fats, sugar, gum, &c. It is thrown out of the animal system in the form of carbonic acid and water; so that such food as contains oxygen in a small quantity, consumes a larger portion of atmospheric oxygen than that in which it is deficient; the quality of food, consequently, greatly affects respiration. Vegetable diet greatly reduces and animal food equally augments the consumption of oxygen. Some of the vegetable salts, as acetate, tartrate, citrate, &c. when swallowed, are partially decomposed in the system, the acid disappears and carbonic acid is substituted. In taking these salts in a state of effervescence, this change is obvious.

Nitrogen is an essential constituent of the body. It enters into combination very slowly. The albumen of the egg and the caseine of milk alike afford this element for the growth of the young. The principal ingredients of the blood, and indeed of every part of the organs, contain 17 per cent. of it, at least. The albumen of wheat, vegetable fibrine, caseine, and gluten contain 15 per cent. of it. The grains, peas, beans, potatoes, cabbage, carrots, turnips, &c. contain portions of it. Nitrogenized food is supposed to be alone capable of conversion into blood, and of forming the animal tissues, hence they are called *plastic elements* of nutrition; while the non-nitrogenized foods go to the support of respiration, in which their carbon and hydrogen are oxydized, and heat is evolved; and hence these are called by Liebig *the elements of respiration.* Of the first are vegetable fibrine, albumen, cassine, and animal flesh and blood; and of the second are fat, starch, gum, sugar, pectine, wine, beer and spirits. Plants, as we have elsewhere said, derive their nitrogen from the ammonia of the atmosphere; and it is probable that animals also derive a small portion from the same source.

Animals cannot subsist alone on gum, sugar, starch or butter, for when thus fed they die in from 16 to 24 days. Thus a person feeding for a month on potatoes and water, passed a large quantity of urine, and was extremely feeble, but recovered in a short time on being fed with nitrogenized food. It has been said, also, that the English negroes, fed on potatoes only, are apt to die of the dropsy, and that the planters found it necessary to allow them milk and bread; and further, that the Irish, who feed chiefly on potatoes, drink sour milk to digest them better. Nitrogenized aliment is not, however, capable alone of supporting life, if we except *gluten.* Animals taking gelatine, fibrine and albumen, separately, die with inanition, but a diet of flesh, bones, or of gluten, collectively, afford complete nutrition. Instances are cited in which life has been prolonged with sugar and also with gum alone, but some other principles were, it is thought, taken in connection with them.

It is an important fact connected with animal and vegetable physiology, and one which may be viewed in connection with the remarks made on vegetable life in a preceding part of this work, that the vegetable organic principles are identical with animal fibrine, albumen and caseine, possessing the same proportions of carbon, hydrogen, oxygen and nitrogen, and also the same relative amount of sulphur, phosphorus and phosphate of lime. The 3 first, fibrine, albumen and caseine compose *Proteine*—from *I hold the first place.* If, therefore, animal or vegetable *proteine* be wanting in food, nutrition is arrested, both in graminivorous and carnivorous animals. The food of all, contains nitrogenized matters identical with the constituents of the blood and tissues of the body, and therefore the elements of gum, su-

gar and oils are not required for the production of the blood. The amount of nitrogenized food is amply sufficient for the growth and to supply the waste of the organs of all animals.

It has been found that a horse will consume, in 24 hours, 7,500 parts of fresh hay, 2,270 of oats, and 16,000 of water—total 25,770, containing 3,938 parts carbon, 446 hydrogen, 139 nitrogen, 3,209 oxygen, and 672 of salts and earthy matters. In this time the excretions are, urine 1,330, fœces 14,250—total 15,580; which, deducted from the food eaten, leaves 10,190 *excess of food*, but a loss in salts and earthy matter of 12. The excess of food in a dry state is 4,565, and of the elements of carbon 2,465, hydrogen 255, nitrogen 24, and oxygen 1,846. Deducting the nitrogen of the excretion from that of the food, the surplus is 370 grs. troy. Thus, if the blood contain 80 per cent. of water, and 20 per cent. of dry residue, of which 15 per cent. is nitrogen, 370 grs. will form 2,457 grs. of dried blood, or 1¼ pounds adv. of common blood daily. The surplus carbon to be thrown out of the system by the lungs and skin in the form of carbonic acid is also shown to be equal to about 4 pounds adv. Hence it follows that nitrogenized foods are alone converted into blood and organized tissues —that such of these as contain *proteine* alone form albumenous and fibrinous tissues—that gelatine is not converted into blood, but may form gelatinous tissues; as the membranes, cartilage, and cellular tissues; and that the non-nitrogenized foods form fat, the carbon and hydrogen of which are burned in the lungs, and thus produce animal heat.

These are deductions from, or positions of Liebig, but statements have been adduced to controvert some of these, with other positions of that bold and accomplished author. We believe, however, that at the present stage of chemical research, Leibig's views will not easily be impaired. No author has of late thrown so much light on animal and vegetable physiology as Liebig, from whom many of these principles are gathered; and we perceive that Dr. Pereira, whose order of arrangement we have observed, has, in most cases, given due credit to that author. Dr. Prout, Boussingault, and others also agree in most respects with that writer.

Alcohol, as well as sugar and fat, is one of the elements of respiration, when taken, and is burned in the lungs. It is absorbed, but does not pass off by the excretions. A large portion evidently escapes by the lungs, after getting into the circulation, as perceived by the odor of the breath. It does not contain the important elements (nitrogen, sulphur and phosphorus) for the formation of tissues. When thus burned in the lungs it is converted into carbonic acid and water, evolves heat, and thereby elevates the temperature of the body. It is emphatically, as Dr. Pereira says, "*a fuel* in the animal economy." In common language, it is taken in cold weather to keep warm, or to

prevent "catching cold." It is therefore temporarily used in cases of extreme exhaustion from exertion and want of food; but a reaction ensues, and its ultimate effects are disastrous. It is apparent that people of cold climates take more spirits than those of warm climates, with less injury; for, as Liebig says, they inhale a more condensed air, take in more oxygen by inspiration, combustion is more rapid, and the alcohol is thereby more readily thrown off. Before it gets to the lungs, however, it exerts a pernicious influence in the circulation on the brain, liver, &c., and there are other and much more salutary combustibles for the support of animal heat. It does not form fat, as its carbon (79) and hydrogen (19·74) are not in the proportion of these elements in fat; nor do we commonly find drunkards fat.

When the non-nitrogenized food, such as sugar, starch, gum, fat, &c. are disproportionate to the quantity of oxygen taken into the lungs by inspiration, the excess forms fat. These contain about 79 carbon to about 11 hydrogen. The conversion of starch and sugar into fat is illustrated by the fact that a goose weighing 4 pounds gained in 36 days, by being fed on 24 pounds of Indian corn, 5 pounds, and yielded 3½ pounds of fat. Fat is evidently converted into most of the principles necessary for the prolongation of animal life, as seen by the absorption of that of the body. The use of fat is evidently as a reservoir of nutriment; for, in the absence of the required food, it is taken up and consumed. It yields carbon and hydrogen for burning in the lungs for the promotion of heat, but it does not renovate. Indian corn contains 9 per cent. of a yellow oil, and a bushel yields 2 pounds. Hay contains 2 per cent. of fatty matter. Milch cows have less fat than the food they have consumed, because it goes to the milk. The food richest in starch, sugar, &c. contributes most to fat in animals. Human fat is composed of carbon 79, hydrogen 11, and oxygen 9 per cent. Turkish women, it is said, by their diet of rice and strong soups, unite the conditions for the formation of cellular tissue and fat; and in the Bey's seraglio they are fattened against a certain day by repose, baths, and a diet of Turkish flour with honey. This is accomplished in 15 days.

A scale of nutritive equivalents of the most important vegetable food has been formed on the proportion of the nitrogen they contain, which is as follows:

Substances.	Equivts.	Substances.	Equivts.
Wheat . .	107	Buckwheat, . .	108
Do. Flour, . .	100	Potatoes, . .	613
Barley Meal, .	119	Do. kept 10 months, .	894
Barley, . . .	130	Do. died at 212, .	126
Indian Corn, . .	138	Lentils, . . .	57
Rice, . . .	117	Turnips, . .	1335

White Haricots,	56	Jerusalem Artichokes,	539
White Garden Cabbage,	810	Carrots,	757
Do. dried at 212,	83	Do. dried at 212,	95
Oats,	117	Horse Beans,	44
Rye,	111	Peas,	67

Thus 44 parts of horse beans, 67 of peas, or 83 of dried cabbage are equal in nitrogen to 100 parts of wheat flour, 138 of maize, or 613 of potatoes. But while these afford the most nitrogen, they are deficient in the elements (phosphate of lime and magnesia) which compose the bones, and are therefore of much less value than others as articles of food; they satisfy the appetite, but add little to the strength. All vegetable poisons contain nitrogen, and some nitrogenized articles of food contain poisonous principles, as with the *solanina* of potatoes and some others of that genus; but these principles are always dissipated or modified, as we have shown, by heat.

Phosphorus is an essential constituent of animals and vegetables. It is an ingredient in the bones and in the albumen and fibrine of tissues, and in nervous matter. It has been thought that an unequal proportion of this substance exists in the brains of sane and insane persons and idiots; but this has not been confirmed. In bones, it exists in combination with oxygen and lime, hence it must constitute an element of animal food. It is an important part of the yolk of eggs, and forms the skeleton of the embryotic animal; and also of milk, by which the frame of young mamals is produced. In the flesh, blood and bones of animals eaten as food, it is an essential element of nutrition. Fishes also abound with phosphoric matter, which is recognized by the phosphoric odor of the breath of those who have eaten much of them. In plants it exists in the form of earthy phosphates in the ashes. It is yielded to them by the soil in the form of phosphoric acid; and they yield it to animals and man, as a constituent of the bones, the brain, &c. It being thus abundantly afforded in plants and animals eaten as food, so much of it as is not required for the above purposes is given out in urine, perspiration and excrement.

Phosphate of magnesia and ammonia constitute a part of the seeds of all the grasses consumed by animals and man. It is chiefly in the outer husks. Horses consume much of it, and hence their cœcum, consisting of these substances, is often as large as a child's head, and sometimes weighs 5 or 6 lbs. Beer derives these principles from the husks of barley; and bread affords it by the bran of the grain. The seeds of peas, beans, etc. contain little of the phosphates, though they yield much nitrogen, and hence their insufficiency as food. An earthy phosphate is abundantly afforded by unrefined sugar. The crust remaining after boiling raw sugar contains 92 per cent. of sub-phosphate of lime. The principal organic constituent of potatoes is also

phosphate of magnesia and ammonia. The earthy phosphates afford in 100 parts 22 of phosphorus. In 1000 parts, the fibrine of animals and vegetables yields 4.3; the albumen 3.3; acids of the brain 21; caseine 13; bone of the ox 9, and of the sheep 11; milk 0.56; blood 0.143; potatoes, dried, 2.5; wheat .792 to 1.98; rye 1.32 to 9.196; barley 0.22 to 1.32; oats 0.352 to 1.32; rice 0.286 to 0.88; garlic 0.242.

Sulphur is likewise a component part of animals and vegetables; it is contained in all the tissues composed of fibrine and albumen. A silver spoon, in eating eggs, indicates it by the formation of *sulphuret of silver*, and a solution of flesh in liquid potassæ also forms a sulphuret. Caseine, hair and bones contain it. Powdered litharge, or oxide of lead, and lime is a dye for coloring hair black, it being the *black sulphuret of lead;* the lime and lead form a sulphuret with the sulphur of the hair. The bones likewise contain it. This sulphur of the body is detected in the sulphuretted hydrogen given off by excrement and putrefying animal substances. This gas darkens the white paint of privies and silver articles in various ways. Sulphuretted hydrogen prevails in the air where there are decaying vegetable and animal substances. The existence of it is undoubtedly the cause of the fatal miasma, so destructive to travellers, especially in Africa. It is said that the waters on the western coast of Africa are impregnated with it to the extent of 40,000 miles. Hence places in the west, where vegetation is rank and is in process of decay in autumn, this gas proves baneful. Urine and saliva contain sulphates, formed by the action of the oxygen of arterial blood on the sulphur of the tissues. The sulphur of the saliva acts on metallic substances placed in the mouth, as seen on the metal used in supporting or filling the teeth. The sulphur of the body is derived from vegetable and animal food. Spring and common water contain sulphate of lime. Most culinary vegetables, as we have before said, contain it; such as celery, hops, rice, ginger, &c. The cruciferous plants abound with it. It is detected in the vapor of charred mustard, potatoes, cabbage, peas, and most fruits.

Iron is a constituent of animals and vegetables, and consequently of most articles of food. The state in which it exists in organic bodies is not exactly known; it is found in the ashes of burned vegetable and animal matter. It is contained in the blood, and is thought to give it its bright red color. Hence the use of chalybeate waters in the disease *anæmia*, in which the blood contains little of it. The quantity in blood differs in different persons. 10,000 parts of blood contain 8 parts of peroxide of iron, or 5.6-10th parts of the pure metal. In the arterial blood, it is saturated with oxygen, but part of the oxygen is lost in circulating through the system; and a protoxide of iron is formed by combining with carbonic acid, which is given off on

coming to the lungs. The hair contains iron; the black colored more than the white. Iron has also been detected in the gastric juice and the chyle. It is found in eggs, milk, mustard, potatoes, peas, cabbage, cucumbers, &c.

Chlorine is an element of the blood and most of the secretions, as in urine, saliva, tears, gastric juice and the fœces. It is combined with sodium in the blood, and in the gastric juice with hydrogen. It being constantly consumed in these states, it requires equally constant renewal. It is therefore taken into the body in the form of common salt, (chloride of sodium.) It is found in the yolk of the egg and in the mother's milk. It is an indispensable constituent of food, hence the strong appetite for it evinced by animals. Persons are too often neglectful of this fact, both with regard to themselves and the animals under their care. It is of the greatest importance in the formation of hydrochloric acid in the formation of the gastric juice. A disordered condition of the functions of this secretion is no doubt often attributable to the want of an edequate supply of common salt. Its composition is *water, gastric mucous, and hydrochloric acid.* The mucous membranes contain mucous, but none other. The juice may be made artificially.

Sodium is a metal (the base of soda), constituting a part of the blood, tissues, and secretions of animals; also of feathers, hair, flesh, bristles, &c. It is received into the system in the form of chloride, &c., and exists in the form of sulphates and phosphates of soda.

Calcium is a metal (the base of lime), and is a constituent of animals and vegetables, as well as of minerals, existing principally united with phosphorus to form the bones. Subphosphate of lime is also a component part of blood, milk, muscles, nerves, the liver, and in fact, most of the animal solids. It is derived from the food from the three kingdoms. It is found in the grains, onions, and most other vegetables. Rhubarb contains the *oxalate*, and grapes the *tartrate* of calcium. It is also derived from well and river water. The Chinese mix gypsum (sulphate of lime) with pulse, to form a jelly, which they eat. A morbid appetite for lime is not unfrequent. It is said that children not supplied with sufficient lime in their food, sometimes collect and eat it.

Magnesium. This metal forms a small part of the bones, nervous matter, &c. of the body. It exists combined with oxygen and phosphoric acid, and often with ammonia. It constitutes portions of vegetable food, and is found in the cereal grains, potatoes, &c.

Potassium is a constituent of animal and vegetable food. We have spoken of this important vegetable product in a previous chapter. It exists in plants combined with the acids, forming salts which are found in their ashes. Liebig says that the production of milk without potash is impossible. It is found in potatoes, grapes, &c.

ALIMENTARY PRINCIPLES OF VEGETABLES.

These are divided into those derived, 1st, from *seeds*, *fleshy fruits*, *roots*, *buds* and *young shoots*, *leaves*, *leaf-stalks* and *flowers*, *receptacles* and *brats*, *stems*; and 2d, from *ferns*, *lichens*, *algæ*, or sea-weeds, and *fungi*, or mushrooms.

Seeds used as food are *farinaceous* and *oleaginous*. Among the most important of the farinaceous seeds are those of the cereal grains, which we have already described, but to which, from their great importance, we shall add some further useful particulars.

The proximate principles of these valuable seeds are *starch*, *albumen*, *fibrine*, *glutine*, *mucine*, *oily matter* (which 3 last are included in *gluten*). *Sugar*, *gum*, *earthy phosphates*, *ligneous matter* (from husks, &c.), and *water*. To these have been added *resin* and a *bitter principle* found in some grains.

Some alimentary substances composed of two simple elements, are denominated *simple aliments*, and the union of these with others, forms *compound aliments*. Water is a simple alimentary principle, formed by the union of two elements; sugar and fat is composed of 3, proteine of 4, and fibrine and albumen of 6 elements. These will be alluded to in order. The simple are the undecomponnded or ultimate elements, as the oxygen and hydrogen composing water, which water and other compound substances constitute separately or when combined, compound alimentary principles.

The ultimate elements of the grains are stated in the last chapter. Their constituents, termed *nitrogenized* or *plastic elements of nutrition*, are vegetable, *albumen*, *fibrine*, *gluten* and *mucine*, and their *non-nitrogenized* constituents or elements of respiration are *starch*, *sugar* and *gum*. It appears that the average time of digestion of the grains when prepared, are—boiled: *rice* 1 hour, *barley* 2 h., and *barley-soup* 1 h. 30 m.—Baked: *sponge cake* 2 h. 30 m., *custard* 2 h. 45 m., *apple-dumpling* 3 h., *corn bread* 3 h. 15 m., do. *cake* 3 h., *wheat bread*, fresh, 3 h. 30 m.

The composition of wheaten bread with distilled water, but without salt, is, starch 53, gummy starch 18, sugar 36, gluten 20. In 100 parts of bread 30.15 are carbon. It does not appear that bread alone is capable of supporting life for a long period, in consequence of the small portion of nitrogen it contains. Oat meal is thought to be as nutritive as wheat flower, since it is found to contain about the same quantity of nitrogen. But having elsewhere spoken of the grains, the legumes, and of bread, we shall reserve further remarks on this subject and the fruits for a future volume. The average composition of peas and beans may be assumed to be, in 100 parts—*starch* 34, *amylaceous fibre* 16, *legumine* 15, *gum* 5, (kidney bean 19), *albumen* 1, *sweet*

extractive matter 3, *membrane* 8, *water* 15, *salts* 4. And the ultimate elements, *carbon* 37, *hydrogen* 5, *nitrogen* and *oxygen* 39, *ashes* 3, *water* 15. The quantity of nitrogen being larger than in the grains, they are thought by some to be more nutritive; thus about 55 to 60 parts are assumed to be equal to 100 of wheat flour; but their deficiency in the phosphates, &c. render them probably less important as food.

Farinaceous or starchy principle. This is obtained from and variously abounds in plants. It is called *amylum*, *starch*, *fecula*, or *farinaceous matter*. It is found in the roots, stems, tubercles, fruits and seeds of almost all plants.

The starchy particles are seen by the microscope to be organized in various forms, each exhibiting a circular spot, or *hilum*, which adhered to the cell containing them. The grains consist of concentric layers, appearing like rings.

The quantity of starch in some important substances is as follows in the 100 parts: *Potato kidney* 9, do. *red* 15, do. *champion* 15, do. *L. orpheline* 24; Tapioca 13, arrow-root 26, ginger 19, tumeric 12, yam 22, barley meal 67, wheat flour 56 to 72, oatmeal 59, rye do. 61, Indian corn 80, rice (Carolina) 85, peas 32, garden bean 34.

The composition of dried wheat starch is, 42 carbon and 57 water; in 100 parts, and these 2 substances constitute similar proportions in the starch of other substances. Starch is converted by digestion into gum and sugar; and this is in part effected by the saliva of the mouth. When cooked, starch is nutritious and easily digested, and is considered a *necessary* article of food. Without it, Dr. Prout says, animals could not exist. A much larger quantity of amylaceous matter may be eaten than of sugar, and for a much longer period. To render it digestible with man it requires to be cooked; and the more effectually its grains are broken the more wholesome it becomes. Thus, boiled and kneaded with water or milk and flour, it is suitable for many uses in cookery. The stomachs of birds and graminivorous animals are capable of dissolving the raw starchy particles, while with man and many animals they pass off unaffected. Hence the saving of nourishment by boiling potatoes before giving them to domestic animals.

Liebig considers that, as starch is a *non-nitrogenized* food, it is an element of respiration, and in the formation of fat is not transformed into blood or tissue. Children, it is further said, fed on salep, arrow-root, or other amylaceous food, not contributing to the formation of bones, become fat; but they do not acquire corresponding strength or an equal developement of their organs. Sago requires for digestion 1, and arrow-root 2 hours. These and other farinaceous aliments being the least irritating, are best for persons with a morbid sensibility, and in febrile and inflammatory diseases; and they remain on the stomach when it rejects all other food. It has been thought, however, of little

value in some forms of dispepsia, as it sometimes passes the system undigested. As animal food requires less modification in the process of assimilation than vegetable food, the animal aliments, and especially jellies, have been used in preference to farinaceous substances in this and other cases where the latter have been recommended.

Of the amylaceous matter of arrow-root, salep, tapiaco, sago, &c. we have elsewhere spoken. The quantity of starch in rice has been turned to account in England by a patent for obtaining it, which is simply by the addition of a weak solution of caustic alkali; and in another patent an alkaline salt is substituted. The still larger proportion of starch afforded by Indian corn is also said to have led to the establishment of manufactories of starch from it in this country. No substance, it has been said by a distinguished physician, is so much relished by infants when weaned, or which is less apt to turn sour, as the tapiaco starch. The milk and other preparations of this and other kinds of starch are made like that of sago; but less boiling is required.

Lignine, or Woody Fibre, as an Alimentary Principle. This is the substance of all vegetable tissues, and is obtained by submitting vegetables successively to the action of ether, alcohol, water, diluted acids and alkalies, in all of which it is insoluble. The proportion of lignine in 100 parts of rice is 4.8, Barley; (husk) 18.75, Oats (bran) 34, Rye (husk) 24, Peas 21, Garden bean 25, Kidney do. 18, Potato 4 to 10, &c. The proportions of this and of other principles in the *fruits* will be given in another volume. *Amylaceous fibre*, often spoken of by writers, is not essentially different from the woody fibre; and its composition is probably nearly the same. In most plants it is composed of nearly equal parts of *carbon and water*.

It is doubtful as to lignine being a nutritive principle with man, though it is the common food of many insects and some other animals. It requires to be reduced and otherwise preprared, when it resembles the amylaceous powders. Under *bread* we have spoken of it as affording that article to the Laplanders, but as *starch* is diffused through the plant by the sap, this may form the nutritive principle attributed to lignine.

It is certain that the ligneous matter of most of our common vegetable food is quite indigestible, and is consequently evacuated. Thus the skin of potatoes, grapes, the peal and cores of apples, and other fruits, and the shells and stones of nuts, plums, cherries, the coats of the grains, seeds of peas, beans, melons, &c., are all incapable of assimilation, and ought always to be removed, as they are very liable to cause obstructions in the alimentary canal.

We do not doubt that many, very many, deaths are occasioned by eating thick and tough-skinned fruits without removing these indigestible and refractory substances before the fruit is eaten; for they very

often resist the operation of powerful cathartics, especially if there is a torpid condition of the bowels. The loss of a son from these causes, though unobserved by the attending physician, has induced the author to notice the importance of these facts, and to call the attention of parents and physicians to them, as he is well convinced that the heedlessness so commonly manifested on this subject is the primary and frequently unknown cause of disease and death with great numbers.

It may be said that, with some of the grains, the external skin or husk acts as a stimulant and mechanical agent on the bowels. This may be true with respect to some of the lower animals, but few persons are willing to acknowledge themselves a horse or a cow. And, although the practice of swallowing these husks may find an apology in the opinion that they are mechanical and stimulating agents, it by no means follows that the husks of all or any other fruits are, in like manner, to be swallowed with impunity.

The vulgar practice also of swallowing the stones of many fruits is not less reprehensible, either from a voraciousness which admits of no regard to safety, or from the not less unreasonable opinion that they contribute to the digestion or wholesome effects of the fruit. The stones of many fruits are known to contain *prussic acid;* and it has been said by some writers that they, as well as the seeds of fruits, should be, or were designed to be eaten. But this opinion can find no fact in science to support it. As to the husks of some of the grains being ground, mixed and eaten with the flour or meal, there can be less objection in certain conditions of the body, but the constant practice is not warranted by the necessities of our nature or the organization of the alimentary system. Certain it is that, in order to afford the required nutriment, a much larger quantity of matter must be consumed, and it is equally certain that the husks do not contribute a particle of such nourishment, nor are they in any form digestible. If the contrary were to be contended for, or the utility of swallowing the husks admitted, the swallowing of most kinds of indigestible trash having no nutriment, with most other kinds of food, cannot be objected to. The fact commonly is that *too much* of the nutritive and unadulterated flour is eaten at a time, or is quite as commonly wretchedly prepared, but this offers no apology for eating an indigestible substance, or for adulterating wholesome and nutritive food.

The external covering of the seeds of the cerealia, and particularly of wheat, is the best form in which lignine may be taken. "Bread," says Dr. Prout, "made with undressed flour, or with an extra quantity of bran, is the best form in which farinaceous matter, can be usually taken, not only in diabetes but in most of the other varieties of dyspepsia, accompanied by constirpation." The fleshy parts of mushrooms are similar to lignine. It is the part remaining of mushrooms after all other parts have been dissolved in water, alcohol, or a weak alkaline sulution.

Vegetable jelly, or the pectinaceous alimentary principle in vegetables has starch for its basis; with *pectine, or pectic acid.* These last are vegeto-gelatinous substances. They are extensively distributed in the various pulpy fruits, as we shall notice in another volume, to which the reader is referred for useful and interesting particulars on this subject. This principle is also found in the carrot, turnip, celery, Jerusalem artichoke, onion, beet, and other roots. Pectine and its acid are analogous, but the first dissolves in cold water, while the acid is not easily soluble. Sugar dissolved in a solution of pectine, forms a partial jelly, which is manifest in the preparation of fruits. It is considered nutritive and easily digestible; perhaps not unlike gum. It is composed of carbon and water, and is considered an element of respiration.

An acidulous principle is also an element of food. Succulent herbs, as well as fruits, contain vegetable acid. Vinegar has been employed in all ages as an aliment, or rather the substances containing it, and vegetable acids are considered necessary for the preservation of health, but they undergo no chemical change in the body, except to combine with a base. Scurvy is a common result of abstinence from succulent vegetable substances having the organic acids; and the beneficial effects of these acids appear to be owing to the existence of a salt with which they are capable of being incorporated in the system. No artificial preparation of these equals the natural fruit or vegetable substance. All vegetable acids are not, however, equally valuable as a constituent of food. They are, as we have before mentioned, highly grateful and cooling ingredients in drinks. But further particulars respecting *vegetable acids* will be given under the head of fruits, particularly *vinegar*, or *acetic acid*, which, as we have seen, is of much importance with solids and other articles of food. Vinegar in a pure state cannot be strictly considered an alimentary principle. The common vinegar may be so considered, from the fact that it contains a portion of starch, sugar, gum and gluten, but it is less necessary in cold climates than in warm ones.

The alcoholic principle we have before alluded to. It should not be considered an alimentary principle. Alcohol has also been detected in the blood, the brain, the urine and the bile.

Oleaginous aliments are the fixed and volatile oils of vegetables; and these, it will have been seen, are before spoken of under the heads of the plants affording them. The fixed vegetable oils affix a permanent greasy stain to paper, while the volatile may be removed by a moderate heat. In the vegetable kingdom, oils are obtained chiefly from seeds, such as rape, poppy, mustard seeds, and nutmeg, also from various roots, described in the next volume. The proportion of this in black mustard is 18, linseed 22, and maize 11 to 18.

The fixed oils are composed of several fatty or saponaceous princi-

ples, each of which is convertible, by a caustic alkali, into a fatty acid, saccharine matter, called *glycerine*, and water; they have, therefore, been called *hydrated salts of glycerine*. Some of the acids are termed *fixed acids*, and others are odorous, volatile, and acrid. Many of the oily seeds and nuts are very indigestible, and being non-nitrogenized foods, they are thought to be incapable of transformation into food; but are employed in the process of respiration.

Liebig maintains that fat may be formed in the body by sugar and starch. It is quite certain that animals derive fat chiefly from vegetables, both by the process of assimilation and from the original oil many are known to contain. The chyle at all times, whether feeding on vegetable or animal food, contains floating globules of oil; and the adipose, as well as the nervous tissues, obtain their fatty parts from the blood. The relative amount of oily matters in the system constitute marked differences in the appearance, the leanness and obesity of individuals. Gall-stones have been attributed to the imperfect assimilation of oily substances. But, notwithstanding the use of oily substances have been much condemned, they are important elements of food, and they are found, in many cases, highly useful, even to diabetic patients. They afford, when they agree with the stomach, a sensation of satisfaction and support not experienced from other food. Butter is more especially an agreeable form of oleaginous food. This is extensively produced in the U. S. 600,000 pounds are annually exported to the W. Indies. For this purpose it is clarified before it is salted, by placing it in a vessel surrounded by water within another vessel, and slowly heating it until melted. After standing for parts to settle, it is turned off, cooled and salted. Butter may be preserved by covering it, when packed, with brine, in which has been dissolved a small portion of saltpetre. Oil is digested with difficulty in most cases; "and although," says Dr. Pereira, "it has been said by some writers, that, taken as a condiment with salads, it promotes their digestion, yet I do not coincide with them." Bone oil, it is said, when taken with salads, is less likely to disturb the stomach than the same or other oily or fatty substances when cooked. *Olive* or *sweet oil* will be noticed in the next volume, under the head of that fruit, with the other vegetable oils.

The volatile oils, which belong exclusively to the vegetable kingdom, are a constituent, as we have seen, of many plants served at table in a raw state, and of the labiate plants generally, as with the seasoning herbs, such as mint, savory, thyme, majoram, &c, This oil is contained in small cells within the leaves. The aromatic seeds and leaves of many of the umbelliferous plants, such as anise, carroway, fennel, &c. are also seen to contain this oil; and it is to it that they, with the preceding, owe their flavor. This oil, in the latter plants, is contained in tubular vessels called *vittæ*, within the pericarp of the fruit.

The cruciferous plants we have described, such as horse-radish, mustard, water-cress, &c., owe their pungency to their acrid volatile oil. These are termed *siliquose condiments*. So also with the *aliaceous condiments* we have mentioned, such as garlic, onion, leeks, &c.; likewise the *spices*, as the nutmeg, cinnamon, cloves, peppers, allspice. The leaves of the peach, laurel, and many others, contain this oil. The volatile oils are much adulterated, as sold from the shops, with resinous substances, fixed, and inferior oils and alcohol. The two first are detected by distillation, and the last by agitating the oil in water, when it becomes milky.

Essences are prepared from the volatile oils by dissolving 1 part of them in 8 of spirits of wine. It is not known that the effects of these oils, as combined with the above substances, serve any other purpose than the gratification of taste; yet it is but reasonable to conclude that they do. They are thrown out of the system, after absorption, in the secretories, possessed of all these peculiar qualities. They are evidently stimulating; and it may be their chief office thus to promote the action of the fluids and solids, and quicken their action. They may produce heat by being burned in the lungs. It cannot be doubted that they exert an important influence in the animal functions.

Albuminous substances. These, with fibrine and caseine, are denominated *proteinaceous* aliments, or the *albuminous principle*. Proteine is composed, per centum, of carbon 55.44, hydrogen 6.95, nitrogen 16.05, oxygen 21.56, in 100 parrs. It exists in organic bodies with sulphur, phosphorus, potash, soda, common salt, &c. The compounds of protiene form the elements of nutrition; and these are produced by vegetables alone, though the power of converting one modification of protiene into another is possessed by animals. In this point of view, says Liebig, the vegetable forms of proteine; vegetable fibrine, albumen and caseine become signally important as the only source of proteine for animal life, and consequently, of nutrition, or the growth in mass of the animal body." These vegetable proteinaceous principles, though, as we have before said, identical with those of animals, are distinguished as *vegetable* fibrine, albumen, caseine and pure gluten. "How beautiful and admirably simple," says this author, "appear the processes of nutrition and the formation of the organs of animals in which vitality chiefly resides! Those vegetable principles, which in animals are used to form blood, contain the chief constituents of blood, fibrine and albumen, ready formed. All plants, besides, contain a quantity of iron, which reappears in the coloring matter of the blood. Vegetables produce, in their organism, the blood of all animals; for the carnivora, in consuming the blood and flesh of the graminivora, consume, strictly speaking, only the vegetable principles which have served for the nutrition of the latter.

Albumen is very nutritious, and is of easy digestion; but its digestibility is impaired by being boiled hard, and by frying. Liquid albumen is coagulated by the gastric juice, and afterwards dissolved. It is said to be the origin of all the animal tissue, and all nitrogenized food, derived either from animals or vegetables; and its principles are converted into albumen before they form a part in nutrition. But animals cannot subsist alone on albumen; they refuse to take it, indeed, after a few days, and prefer to suffer hunger and death. *Caseine*, constituting chiefly a part of animal substances, milk and cheese especially, does not claim so much attention here.

Fibrine, in the gluten of *wheat flour*, and *rye meal*, is composed, in 100 parts, of the first named—Carbon 54, hydrogen 7.200, nitrogen 15.500, oxygen, sulphur, phosphorus 23, and in that of rye meal of nearly the very same elements. The proximate or *proteinaceous* principles of vegetables, Liebig says, are identical with the fibrine, albumen and caseine of animals, and also the gluten.

Vegetable fibrine is most abundant in the cereal grasses, in many rich fruits and fresh vegetable juices, as beet roots, carrots, turnips, &c.; and it is seen to coagulate from these by standing.

The albumen of rye is composed of carbon 54.74, hydrogen 7.77, nitrogen 15.85, oxygen, &c. 21.64. These principles are equally as nutritive in vegetables as in animals. In the latter they form blood. These important elements are indeed chiefly obtained by animals from the vegetable kingdom.

Vegetable albumen abounds in the cerelia. It is likewise found abundantly in oily seeds, as with the nuts, &c. A considerable quantity is contained in vegetable juices, as in those of the cabbages, carrots, cauliflowers, asparagus, turnips, and most cultivated nutritive vegetables. It is separated from its coagulum of fibrine. *Vegetable caseine*, or *legumine*, is obtained chiefly from leguminous seeds, as peas, beans, &c.; also from oily seeds, or nuts, and vegetable juices.

Gluten remains after the starch, gum, sugar, and albumen are washed from wheaten dough under a stream of water. When boiled in alcohol it is formed into 2 parts; one is held in solution, and the other is insoluble in it. This last, according to Leibig, is *vegetable fibrine*, and the first is *gluten*, which is supposed to consist of *mucine* and *glutine*. The composition of gluten, in 100 parts, is *glutine* 20, *vegetable fibrine* or *albumen* 72, *mucine* 4, *oily matter* 3, with traces of *starch*. The proportions of this in wheat vary according to soil and culture, from 9 to 35 in 100 parts. Manured with human urine, it yields 35, and the fœces 33.94, ox blood 34, horse manure 13, cow do. 11.96, pigeon do. 12, vegetable humus 9.6, and without manure 9.2. Rice yields 3.60, maize 3, beans 5.758, dry peas 10, potatoes, 3.5 red beet 1.3.

Gluten is of easy digestion by the acid of the gastric juice; it is

highly nutritious and is capable alone of the continued nutrition of animals; but an aversion to it is excited in animals obliged to subsist entirely upon it. It is without odor or flavor, and is sometimes nauseous; yet it has been given to animals, by Magendie, without distaste, in doses of from 1850 to 2300 grs. daily, for 3 months, they preserving excellent health. This appears to be opposed to the received opinion, that one aliment alone is unfitted for prolonging life beyond a short time; but in gluten are found two or more different substances. It is to gluten that wheat flour owes its chief nutriment and susceptibility of being made into bread. *Gluten bread* has of late been made for diabetic patients; and it seems well fitted for dispeptic persons.

The gelatinous principles of food have been thought a modification of albumen, but these, with the tissues formed of them, are said to differ in their properties and composition; and the one has not been converted into the other. The composition of proteine compounds is said to be identical with the flesh and blood of animals, while those of the gelatinous tissues are not; therefore the nutritive qualities of the former are not the same. The albuminous tissues are insoluble in water, and become hard by boiling, while those of gelatin become soft and tremulous, forming *gelatin* or *jelly*. Such compounds as soups, hashes and stews, from the gelatin they contain, are said to be objectionable with dispeptic persons and invalids, in consequence of the changes effected in the gelatin by heat; but certain gelatinous foods must be excepted. These gelatinous principles, however, are more especially connected with animal food, of which it is not our province now to speak.

The variety of alimentary substances in the vegetable kingdom are much greater than those of animals, and from the difficulty commonly of determining the nutritive properties of these, our subject assumes great importance with every reader.

The saccharine alimentary principle. Of the general properties of sugar, and as a product of the cane, we have spoken in the 2d part of this volume, and also as an article of commerce and domestic use; it is, however, a constituent of vegetables, generally, and also of animals. The cereal grains contain portions of it, varying from 1 to 8 per cent. The fruits, and some of the roots especially, abound with it. The highest proportion in fruits is the fig, 62.5, and of the roots in the carrot juice evaporated to dryness, 93.71. Of that in the fruits we shall speak under the head of fruits. It has heretofore been considered a nutritious principle, but Liebig affirms that it is chiefly an element of respiration. Brown sugar is said to be extensively adulterated with sugar prepared from potato starch and from that of sago flour.

The mucilaginous alimentary principle is extensively diffused in the vegetable kingdom, in the form of *gums*. It exudes spontaneously

from very many plants, and is an important article in medicine and in the arts. Of the gums thus used we shall speak particularly in the next volume. The grains contain from 1 to 18 per cent. of mucilage, the largest proportion being in wheat flour. Rye meal also contains 11 parts in the 100; the kidney bean 19.37, and marsh-mallow root 35.64. The properties of the gummy matters in different plants differ materially. Gums likewise differ much in their composition and solubility. Their chief constituents are carbon and water. They have been thought to possess nutritive principles, but are now considered an element of respiration, as before asserted. They are of difficult digestion, and therefore not apt to agree with dispeptics; still they are employed by invalids as a demulcent and in some inflammatory diseases. In coughs, irritations of the throat, &c. they are used in various forms, as we shall hereafter show.

Water. It has been stated throughout this work that water is a paramount and an essential constituent of plants, and consequently of vegetable food. It is equally essential in all the vital functions of animals; hence it was anciently thought the primary principle of vitality. It is seen to compose a large portion of the organs of human and animal bodies, as well as of all plants, with the exception of some few infusoria and mosses. Flesh contains about 74, and the blood 80 per cent. of water; thus it is estimated to constitute about *three-fourths*, by weight, of the human system. This being rapidly consumed by the secretions, it follows that both animals and plants must be often and abundantly supplied with it. In this respect it is more essential to animal life than solid food, and is intermediate between that and air.

Some, however, have considered it unimportant as a drink, and have abstained from its use; but they have, nevertheless, consumed it in nearly equal quantities in succulent vegetable food. As this is composed of nearly 5-6ths of water, and as the quantity of water drunk by an adult in health is about 6 pounds in 24 hours, it is probable that a free use of succulent vegetables affords nearly, if not quite, as much water as that usually drunk by an individual. It is not so important as to how this fluid is taken; but that it is essential to health and the functions of the body, no rational person will deny, when it is considered that about 40 oz. are given off from the skin and lungs in 24 hours, in addition to that passed otherwise.

Entering into the composition of most solid food, it is taken into the stomach in that state and in drinks. It is in the form of a hydrate in many substances, as in starch, sugar, albumen, &c., or when these are in a moist state. It exists in the grains in the proportion of 14 to 20 per cent., legumes 14 to 16, potatoes 75, turnips 92, carrots 87, beet root 87, and most other edible roots in like proportions; cabbage 92.

It is not known that water is decomposed in the animal system. Liebig says the tissues of vegetables are derived from water, thus exerting a vital influence throughout the vegetable kingdom. The tissues of the body are also modified and rendered flexible by it. It aids digestion by acting as a solvent, and is instrumental in converting acids into urea in most animals, birds and reptiles excepted. It combines chemically in converting the sugur of cane or starch into the sugar of milk, and in other combinations in the animal economy. It is used in many diseases as a dietetical remedy, and in numerous ways holding in solution nutritive food. But its use is restricted in what is called a *dry diet*, to limit the fluidity of the blood and retrench circulation in valvular diseases of the heart, by affecting the coagulation and deposition of fibrine.

The quality of water is of the greatest importance to the health of plants and animals. It is divided into *common water*, as used in ordinary drinks, and for domestic purposes, *sea water* and *mineral water*. *Distilled water* may be obtained from any one of these. Common water is known as *well* or *pump*, *river*, *spring*, *lake* and *marsh* waters. Rain water is the purest of these waters; it is, however, much less pure at the beginning of a shower than after raining a few hours, as it at first brings down the impurities suspended in the atmosphere. It contains at all times a portion of air, and generally a portion of *carbonate of ammonia*, yielded to the air by decomposing organic substances, as we have mentioned in the last chapter. It is this ammonia which affords nitrogen to plants, renders water soft, &c. Other substances, such as metalic and earthy salts, are also found in rain water, especially when it first falls.

Rain water in cities, if collected from the roofs of houses, has impurities, and should be boiled and strained before use. *Snow water* is devoid of air and other gaseous principles, and hence fishes will not live in it. When in the state of snow it does not quench thirst, but increases it, hence the people of northern regions suffer extreme thirst rather than eat it; but when melted it allays thirst like other waters. *Spring water* is rain water which has passed through the earth and appeared again at its level on the side of a hill or mountain. It usually takes up in its passage earthy salts and such other soluble matter as the soil contains. *River water* is both rain and spring water, commonly holding in suspension several impurities, especially decomposing vegetable substances, oftentimes in sufficient quantities to have deleterious effects, as commonly recognized in producing a relaxation of the bowels, dysentary, &c.

An analysis of the Croton water of New York gives in 1 gallon, *carbonate of lime* 1.52 grs., *sulphate of lime* .44, *chloride of calcium* and of *magnesium* .90, *carbonate of magnesia* .84, with traces of *vegetable matter and iron*—total of solid matter 4.16 grs. in the gall.

This is doubtless the most favorable condition of the water. *Manhattan water* contains in Reed and Chamber streets 125, in Bleeker st. 20, and in 13th st. 14 grs. of solid matter in the gall. The wells in the lower parts of N. Y. city contain 58 grs. of solid matter. The water of the Boston wells, from which that city is supplied, is brackish and hard; and 682 of the 2,085 drinkable, are unfit for use. but 7 wells yield soft water, and but 2 of the 32 wells made by boring, contain soft water. The water of the Schuylkill, which supplies the citizens of Philadelphia, is one of the purest streams in the country. The water of the Thames, near London, contains about 20 grs. of solid matter. 30 galls. yield also 28 grs. of a carbonaceous substance. When taken to sea, it soon becomes putrid and offensive from decomposing organic matter; but if racked off into larger vessels and exposed to the air, it deposits a thick slime and becomes sweet.

Well or pump water contain substances like those in river water, but generally in greater abundance in populous places. It is therefore *hard* or *soft* in proportion to these constituents, especially the *sulphate of lime*. The action of this salt with soap is that the sulphuric acid unites with the alkali of the soap, setting the fatty portion of the soap free, which combines with the lime of the salt and forms an insoluble compound, hence called *hard*. This water dissolves organic substances less perfectly than rain water, and is therefore less useful for making decoctions, as in teas, in beverages, and for drinks in dispepsia; it also occasions urinary deposits. It induces constripation and disordered digestion in some, but with others, or differently combined, relaxation and diarrhea. To the horse it is especially injurious; and he instinctively rejects it when river water is to be had: it makes his coat *stare*, and often gripes him. Water should rarely be conducted through leaden pipes, particularly if a piece of polished lead will not remain untarnished in the water 24 hours. Croton water cannot therefore be safe conducted through leaden pipes. Water ordinarily acts on the pipes of beer pumps; hence, it has been said by Dr. Lee, that it is not uncommon for porter house keepers and others to be attacked by palsy in consequence of their drinking beer in the morning which has been standing in the lead pipe during the night.

Marsh water, though like lake water, yet being stagnant, it contains much putrescent vegetable matter. This matter decomposes the sulphates in sea and other waters, and causes an evolution of sulphureted hydrogen, occasioning the offensive smell from marshy and swampy grounds. Carbonic acid and air being given off by water when boiling, the carbonate of lime held in solution is deposited, as seen by the incrustations on tea kettles and boilers. Water containing carbonic acid will deposit a white precipitate by adding lime water. Litmus or syrup of violets is turned red by water which has free acids in it. Tincture of galls turns water black when it has iron in it. *Fil-*

tration deprives water of living objects and impurities suspended in it. *Distillation* is the best mode of purifying water, but its taste is flat and unpleasant, in consequence of the absence of air and carbonic acid. The distillation of sea water for use at sea has been attempted of late with what success we do not know. Pure water on shipboard, as elsewhere, is a subject of great importance, as the impurities of water are the cause of numerous diseases.

Alum cleanses muddy water, 2 or 3 grains answering for a quart of water, but renders the water harder; it does not therefore render it chemically purer. Alkaline carbonates contribute to soften water by decomposing the earthy salts; and the addition of lime precipitates carbonic acid and sulphate of lime.

Sea water includes that of the ocean and of inland seas having the same composition. It varies in amount of solid matter in different seas. That of the Medeterranean contains 410 grs. of solid matter in 1000 parts; that of the English channel 380, of the German ocean from 200 to 345, the Baltic from 66 to 168. The average quantity of saline matter is therefore assumed by Dr. Pereira at 3½ per cent., and the mean density at 10.274. The composition is about 964 water, 27 common salt, 2 sulphate of magnesia, 3 magnesium, sulphate of lime, with fractions of other salts. In moderate doses, it is useful in scrofulous affections, as in grandular enlargements, mesinteric diseases, &c. Topical applications of it are stimulating, and it is used as an embrocation in chronic diseases of the joints. Persons are less likely to take cold after a salt water bath than a fresh water one.

Mineral waters, like sea water, are not useful for domestic purposes; but, as drinks, they are much used for medicinal purposes. Those in which iron predominates are *chalybeate* or *feruginous*. Some of these contain a carbonate of iron, and are *carbonated chalybeates*. Some are impregnated with sulphuretted hydrogen, and have the odor of rotten eggs; these are *sulphurous* or *hepatic* waters. Some are brisk and sparkling, with an acidulous taste; these are *carbonated* or *acidulous* waters, and others are *saline*. But these require no further notice here.

NUTRITIVE QUALITIES OF FOOD.

We have shown that the amount of water in vegetables is very great; and that it differs in different plants; the nutritive properties therefore, depend much on this circumstance. Those substances which possess little or no water, are called *anhydrous*, but these are not always nutritive, as shown under *Lignine*. Green resinous matters of plants are likewise wanting in nutriment; hence of the solid nutritive portions of vegetable food, the woody and coloring parts are to be deducted. Again, those constituents of plants which are called *nitrogenized*

are distinguished from those called *non-nitrogenized*. The last depend for their value on the amount of carbon they contain, as shown under *Carbon* and *Fats* or *Oils*, which contain most of it. It will be seen under *Proteine*, also, that its alimentary principles, fibrine, albumen, caseine, being the same in composition as the flesh and blood, afford the greatest amount of nutriment.

The following table shows the *elements, the amount of solid matter* and of *water*, of some of the principal vegetable substances. We give the average estimates and avoid fractions.

Kinds of Food.	Solid Matter.	Water.	Carbon.	Nitrogen.
Sugar,			36 to 42	
Starch,	81 to 85	14 to 18	36	
Wheat,	85	14	39	1.966
Rye,	83	16	38	1.417
Oats,	79	20	40	1.742
Peas,	84	16	36	3.838
Beans,	85	14	38	
Lentils,	84	15	37	
Potatoes,	24	75	10	
Cabbage,	7	92	3	
Carrots,	12	87		
J. Artichoke,	20	79	9	
Turnips,	7	92	3	
Milk,	12	91		

The time for digesting some vegetables, is—Beans 3 h. 30 m. (pod), potatoes 3 h. 30 m., carrots 3 h. 15 m., turnips 3 h. 30 m., beets 3 h. 45 m., milk 2 h. 15 m., do. boiled 2 h., beans and corn 3 h. 45 m., parsnips 2 h. 30 m., cabbage with vinegar 2 h., do. head 2 h. 30 m. do. boiled 4 h. 30 m.

The conclusions of Magendie in relation to some alimentary principles are—that extracts from bones cannot be made a substitute for meat—that gelatine, albumen and fibrine, taken separately, nourish only for a limited period, are incomplete, and excite an unconquerable disgust; and that, though united or rendered more agreeable by seasoning, &c., animals eating these exclusively, ultimately die with inanition—that muscular flesh, in which these are united according to the laws of nature, and when in connection with fats, oils, &c., are sufficient, even in small quantities, for continuous and complete nutrition—that the preparation of bones, or transformation into gelatine, diminishes their nutritive qualities—that gluten from wheat or Indian corn alone affords complete nutrition—that fat alone will support life for some time, but that nutrition is disordered and imperfect.

The digestion, or assimilation of food, is the process of converting

alimentary substances into organized portions of the body. In this the first process is the conversion of food into blood, and second, the formation of tissue, &c., from the blood. In the preparation of the food two substances are necessary, the *hydrochloric acid* and *chymosine*. The first is said to soften the food and cause it to swell up, while the second liquefies it. These substances are secreted in the lining membranes of the stomach by a vital process. Digestion is chiefly a chemical process, and may be performed out of the stomach by an artificial liquor prepared by the maceration of the dried lining membrane of the 4th stomach of the calf in a weak solution of hydrochloric acid. By the action of the gastric fluid, sugar, fatty and oily matters, starch, gum, &c., are divided into minute parts; and subsequently the proteinaceous substances are absorbed and converted into chyle.

The process of digestion is generally slower with vegetable than with animal substances; but oils and fat are very difficult of digestion. Some of the former, pass the stomach, in a crude state, while others are retained; thus it is with cathartic medicines, many fruits, seeds, &c. The artificial preparations of many kinds of food also render them difficult of digestion, while others are so modified by art as to be easily digested. It is said that violent exercise in animals, just previous to death, renders their flesh more tender, and that the practice of bull-bating and whipping pigs to death may have originated in a knowledge of this fact. It is also believed that flesh kept for some time after death, or which is in the first stages of decomposition, is more easily digested than fresh meat. That of young animals is thought to be more tender and soluble, but not so digestible as that of older animals. The stomach disposes of solid more readily than fluid food; though, in an exhausted condition of the body, the latter more readily restores strength.

It is of the first importance that food should be minutely divided, as the time of digestion is much shortened by it. Thus potatoes, fruits, and other vegetable substances are more easily digested by being soaked, so as to be susceptible of easy mastication. Some of these are much more so from their structure than others, as with mealy potatoes, &c. The complete mastication of food by chewing cannot be too forcibly impressed upon the attention of all, and especially dispeptics. The complete mixture of food with the saliva is also necessary to digestion. When this is not done, a desire is always manifested to swallow drinks to moisten the food eaten; but this cannot be so well calculated to effect the object designed by insalivation.

The process of cooking is designed, in addition to the gratification of the taste, to destroy the organic structure of food; hence this is almost universally practiced by civilized people, with most organic substances. The modes of cooking effect some remarkable changes in the elements of food, as with poisonous plants, &c. But this change

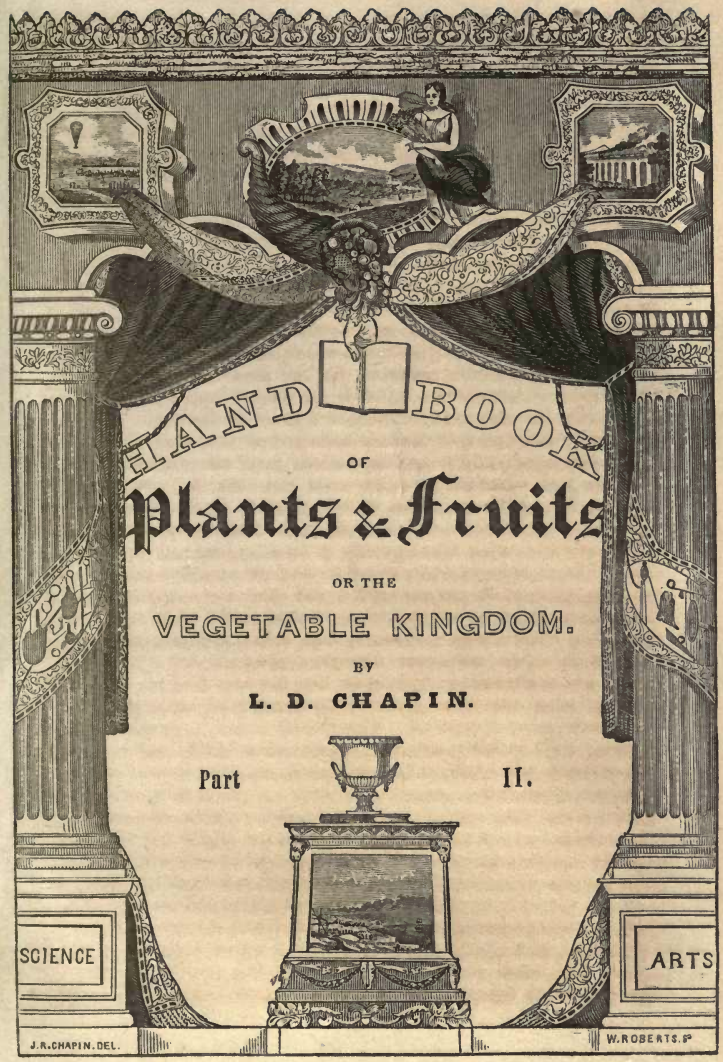
natural food; the carbon by the sugar of milk, and this with hydrogen in butter, both going to respiration. The constituents of its blood are derived from the caseine of the milk; and these are sufficient for the metamorphosis of tissues, &c. The fondness of children for sugar is explained by their necessities for its use in respiration. This is obtained from the mother's milk; but oftentimes too little is afforded in this way, or by hand nursing. Fatty matter supplies its place in northern regions.

It has been well said, "the natural appetite is an index of the wants of the system," and, although there are cases in which prudence would withold substances desired for consumption by children, yet cases are not unfrequent in which the appetite is a better guide than the judgment of parents. Neither animal nor vegetable food, when craved, should be witheld in most cases. Whenever sugar, starchy, or fatty matters are taken in quantities more than sufficient for respiration, they contribute to the accumulation of fat. Nitrogenized food furnishes the materials for the growth of the bones, cartilage, muscles, membranes and cellular tissue; and milk affords, by its caseine and phosphate of lime, the elements for these purposes; these are also supplied in the flour and meal of the grains, when eaten.

A deficiency of food causes in children many bowel diseases, which are often best controlled by potato stew, pea soup, &c. Insufficiency and inequality of food are also sources of many other diseases, much more frequently than parents are aware of. Commonly, there is little danger of overfeeding, if the quality of food be good and properly varied. The children of the poor, and those especially in poor houses, are believed to be in general smaller and shorter than the children of those by whom they are well fed. Boiled milk, beef and mutton soups, rice cooked in various ways, with bread, are recommended for children under, and even over, nine years of age.

But, as dietetics naturally lead us into the consideration of animal food; as indeed they have already incidentally done, we shall conclude these miscellaneous remarks. The subject is one, however, of much interest; and further particulars, under other heads, and especially that of fruits, will be found in a future volume.

Sugar & butter for respiration.


HAND BOOK
OF
Plants & Fruits
OR THE
VEGETABLE KINGDOM.
BY
L. D. CHAPIN.
Part II.
SCIENCE
ARTS
J.R.CHAPIN. DEL.
W.ROBERTS. SC

INTRODUCTORY REMARKS

As preliminary to the second part of this work, circumstances render it necessary to add a few remarks to those made at the commencement of the volume. It will be seen that the following pages differ materially from the preceding. It was our design in the first division of the subject to condense some of the most important facts in relation to the life, habits, structure and general character of plants, reserving for the second part a brief notice of the most useful and remarkable properties of particular plants and their fruits. But the subject, from its great interest, has insensibly grown in our hands, however far short of its merits the present work may appear.

Both parts having been finished, we should do injustice to ourselves and others, did we not avail ourselves of this opportunity to express our apprehensions of disappointment with some who might very naturally look for more or particular information on branches of a subject so fruitful of interest, and did we not at the same time express our obligations to sources of information which the volume may be found to contain. The same remarks are due from us in respect to either part. The choice of topics in both departments being, however, left with ourselves, as well as the manner of their execution, we must trust to the majority of our readers for a favorable decision upon the merits of our choice and labor in both.

Many other departments of the subject might have been introduced, and much more have been profitably said upon those we have presented, but that would not have corresponded either with our limited space or our original design. It is apprehended, indeed, that we have condensed too much within our allotted space, and that this has been done at the sacrifice of perspicuity. To us this appears the most obvious fault, and we therefore beg of our readers a repeated and more careful perusal. The whole having been written with a view to embrace a greater number of useful facts than most works on the same subjects, we could not have enlarged upon any one of them, or more fully illustrated their extent and importance, but by the exclusion of other facts and other subjects. Under these circumstances we trust our readers will look rather for useful facts than for any display of language or power of illustration. The book, consequently, if read as we designed it should be and as its numerous particulars evidently require, will be perused often and carefully.

That we are under obligations to numerous sources for facts embodied in the work, it will scarcely be necessary for us to assert. Like most works on science, and especially on this branch of it, where the extended and combined observations and long practical experience of so many are necessary

to disclose and establish the many and important truths it embraces, ours is equally indebted to the experiments and researches of patient and distinguished men. We should not, and we cannot, therefore omit to express our sense of obligation for the interest which those observations and experiments confer on the present volume. In addition to the sources already enumerated in the first part, we would mention Loudon, Johnson, Barton, Bell, Meeks, and the English and American Materia Medicas. Still, it may not be irreverent to say that every word of the work has been written by us with great care and much labor, requiring in its execution the undivided time of more than a year, and necessarily demanding patient and extended inquiry. In this, however, we have been animated by the conviction that our selection and arrangement of subjects, and compression of the most useful and remarkable particulars within the wide range of so interesting a subject, was much wanted, and would be received with general favor and liberality. And we cannot now deny ourselves the pleasure of anticipating a favorable view of our design, and the importance of the many useful facts we have given in the work, whatever that view may be of the style and manner in which our design has been executed.

In noticing particular plants, in the following pages, such only have been described as have some useful or remarkable properties; nor have we included *all* such, for this would have swollen our work to double its present size. But those most valuable to man as food, or as used in the various purposes of life, and those, whether native or foreign, most essential to the existence of lower animals, have been carefully presented and their known qualities enumerated. Some errors and confusion may arise in this, from the local, and consequently various, names given to plants. We may have erred ourselves in this particular, and the same plant may therefore be described twice in some instances. But when the difficulty is so general and obvious, not only with the public, but with all writers, we hope to escape censure for that, at least, which was unavoidable.

We have in all instances given the popular name when that is known, and the botanical name when it is unknown, or doubtful. It is greatly to be regretted, that uniformity has not been or cannot be obtained in this very important matter. An effort is imperiously called for, in our opinion, to accomplish this great object. English authority, in this respect, serves only to render the difficulty still greater, for there, as here, the popular name has originated oftentimes from the caprice or ignorance of the people. Superstition and fancy have also contributed to the diversity of names in other parts of Europe.

In regard to the nativity or locality of many important plants, great difficulties also exist, both as to the country and the particular parts of the

country they inhabit. British authority, to which we are often induced to refer for the character and habitation of plants, is studiously silent or egregiously erroneous in reference to most American plants, and some of our own writers differ much as to their classification and qualities. Again, the properties of some plants vary much from their situation, modes of culture, and varieties. The medicinal properties of many plants are likewise very unsettled among medical men. Many of those we have noticed are not now used at all, though formerly in high repute for their great and various medical qualities. For the most of those described, however, we have referred to London and American Materia Medica; so that errors, in some of these particulars, are not unavoidable.

The study of our subject is the study of nature; nature in her most admired form and aspect, rewarding her votaries with enobling and enduring pleasures. And he who passes on coldly, indifferently, stupidly, in the midst of her beauties and wonders—

> "Who ne'er has felt her hand assausive steal
> Along his heart—that heart can never feel."

Insensible indeed must be the mind that cannot be awakened to the rich and joyous scenes around us. Here, if any where, ignorance and indifference are synonymous; ignorance without bliss, indifference without freedom from care. But the mind of the attentive and enlightened observer; he who holds up natural truths in the light of science is thrilled with pleasure, steady and exalting pleasure, as new truths burst forth at every step; where each plant, flower and fruit is a miniature world of thought. The tree that was viewed only as a thing to be cut down and burned, puts on new features, inspires new themes of interest and association within and around. The birth, nature and destiny of these become objects of new and profitable reflection. Flowers—but what can be said anew of these nurslings of nature, the fresh and laughing innocents of her care and love—No where, then, can mind find a wider range or more fruitful field of ennobling thought. As knowledge increases, new pleasures thicken in our path; and it never should be forgotten that unhappiness is not so much from the want of objects of enjoyment as from the will and ability to enjoy those we possess. Here the highway is every where lined with new objects of pleasure and admiration. There is no monopoly here, no locked up treasures we cannot reach, no special interests we cannot share, but all is open as light and as free as thought.

Need we urge the reader further, however, when his own interest and nature herself present inducements more numerous and strong.

EXPLANATION OF TERMS.

In cases where we do not give the *generic name* in italics, it is the same as the popular name. And where the *family name* is omitted, it is like the *popular name*, in capitals, or is not thought of special importance, or has been mentioned in describing the genus which belongs to it, and therefore not necessary to be mentioned in the species under consideration. But one species of a genus may be worthy of notice, in which case we have given the *popular*, the *specific*, the *generic*, and *family*, or divisional names. The *varieties*, in most cases, have not been mentioned, as they are supposed to possess the same general properties as others of the species.

The *generic* name of plants, when not given as the *popular* name, is the first of the scientific names in italics, which are the generic and specific names together. Thus, for example, the *Pea* is the *popular* name of the pea plant; it is of the genus *Pisum*, of the species *sativus*, and of the family or division of plants *Leguminosæ*. The name of the natural family is commenced with a capital and is not italicised. To avoid repetition, the initial letter of the genus is placed before the species, as N. tabacum (*Nicotiana*) tabacum, &c. The *class*, in the Linnæan arrangement, is signified by the letter (C.) and the figure following it denotes the number of the class the plant belongs to. (O.) signifies the *order*, and the figures following it the number, or what order the plant is in. *Sp.* stands for *species*, and the figure before or after it denotes the number of the species in the genus; and where two or more figures follow *sp.*, and are divided, the *first* one or two signifies the number of species which have been described or cultivated; and the *second* one or two is the number of species which are known to belong to the genus.

(D. u. s.) stands for *Deciduous under shrub.* (D. c.) stands for *Deciduous climber* or *creeper.* (D. t.) for *Deciduous twiner* or *trailer.* (D. s.) for *Deciduous shrub.* (D. t.) for *Deciduous tree.* (D. h.) for *Deciduous herb.*

(E. t.) stands for *Evergreen tree.* (E. s.) for *Evergreen shrub.* (E. h.) for *Evergreen herb.* (E. t.) for *Evergreen twiner,* or *trailer.* (E. c.) for *Evergreen climber* or *creeper.*

(B. r.) stands for *Bulbous rooted plant.* (T. r.) for *Tuberous rooted plant.* (F. r.) for *Fusiform* or *spindle* shaped rooted. (a.) stands for *Aquatic plant.* (p.) for *parasite.* (A.) for *annual plant.* (P.) for *Perennial.* (B.) for *Biennial.*

(ft.) stands for *feet,* and the figures following or preceding it are the number of feet the plant is high. If there are two or more figures divided, they signify that the species are from — to — feet high. In class 24, or the Cryptogamous plants, (T.) signifies the tribe to which the plant belongs, and the figures, the numbers.

For an illustration of these abbreviations take TOBACCO (the *popular* name) *nicotiana tabacum,* or Virginiani, the *first* is the *generic* and the *second* the *specific* name,) C. 5 (class,) O. 1 (order,) Solanæ (natural family,) sp. 14–26 (*i. e.* 14 species described and 26 belonging to the genus,) A. (annual,) 4 ft. (4 feet high.)

Those desirous to examine or preserve any particular plant described, whether indigenous or foreign, can apply to Prince's Botanic Garden, Flushing, (L. I.) or any large garden of the kind, or at the seed stores, where the seeds may also be obtained.

Class 13, *polyandria,* is class 12 with some, and the 4 orders after the first, are embraced in one (*dipentagynia,*) instead of the orders as in Linneas. Our classification is according to Loudon, but alterations have been made and the *natural order* is now much adopted, as we have often done, to conform to practices in particular cases.

THE

CEREAL GRAINS OR CORN PLANTS.

No class of vegetable substances is so important to man as this, either as contributing to his luxuries or as comprising articles of prime necessity. The power and prosperity of every people and nation are likewise immediately dependent on the cereal grains, their nature, quantity and quality; so that no subject can be more worthy of our consideration. In view of these facts—which must be apparent to every observing mind—it becomes a matter of great interest and satisfaction with every American to contemplate the immense and rapidly increasing productions of our country. And it cannot be less a matter of curiosity and instruction to examine the nature and properties of substances thus important to ourselves, to the world of mankind, and to a large portion of the whole animal kingdom.

All farinaceous seeds are divided into two classes: the first are those of annual plants, comprehending the true grasses, or corn growing plants. These are called *cerealia*, (from *Ceres*, the Goddess of Corn.) The particular kinds of grain upon which a people chiefly depend are called by them *Corn*, as the wheat, *maize*, (or Indian corn) &c., in the United States; wheat in England; rye and oats in Scotland; rye around the Baltic; rice in India, &c. The second class of farinaceous seeds are also chiefly from annual plants, but they are contained in pods, or *legumes*, and hence are called *leguminous* seeds, or *pulse*. All vegetable productions, useful as food, are *farinaceous* (from *farina*, meal,) and such may be ground into meal, or flour. The form of farina is sometimes almost a limpid fluid, and at others as hard as wood. Such vegetables, therefore, as contain the most farina are best for the food of man. Both seeds and tubers (extending under ground by farinaceous deposites) when mature, are consequently farinaceous.

Corn plants are all annuals in their roots and stems, as the plants die after maturing their seeds. Their stem is a straw, or *culm*. This is hollow and jointed, with leaves at each joint. The stem contains silex, or flinty earth, which is useful in the arts, as well also as the ashes. The principal corn plants are Wheat, Maize, or Indian corn, Rice, Rye, Oats and Barley. The cereal grasses, however, comprise many other grains, and some little less important. Wherever these

are found, man is generally seen to be advanced in civilization. The wheat found buried with the ancient Egyptians, and some other people of the East, indicates their civilized condition.

Corn plants, as they are now found, do not generally grow wild in any place. Some few species of an inferior character found in a wild state, may be greatly improved by cultivation, as those have been which are now cultivated; but such, with many other useful vegetables, have generally followed the course of Man. They have attended conquests and commercial intercourse. Cortez introduced some of the most valuable plants into Mexico. Wheat followed the conquests of the Romans; the vine those of the Greeks; cotton, &c. those of the Arabs; and very many useful plants have come to this country through the English and French. Maize only, of the cereal grasses, was found in Mexico at the time of the conquest, and in North America at the period of its discovery. The first seeds of wheat in the New World were three or four found, in 1530, by a slave of Cortez among some rice. The Indian planted them, and thus conferred on that country an imperishable blessing. The rice of this country was sent in a small bag as a present to a gentleman in Charleston, S. C., not 150 years since, and now it is not only a principal article of food here, but is exported in large quantities to the place whence it came. The potato, a native of America, was taken hence to England and Ireland in 1586, and a few hills only planted, but it is now the chief article of food there and in other parts of Europe and the Eastern world.

The distribution of corn plants depends mainly on climate. They cannot be traced beyond the 60th degree of North latitude. In more southern parts of Siberia, however, they are abundant. Buckwheat there yields six crops successively with but one sowing; oats are likewise excellent. In Lapland plentiful crops of rye are produced, and still further north potatoes supply the place of grain. South of Siberia and in Kamstchatka the cereal grains are not at all cultivated, which is attributed more to the soil than to the frosts. Oats and barley are found farthest north in Europe. Rye is next; and in parts of Sweden, Norway, Denmark, and the north of Germany it is the chief article of cultivation. Being a hardy plant, it is more suitable for those latitudes; and no where is it so much cultivated. The harvests of Norway, notwithstanding its intensely cold climate, are generally good and abundant. In Sweden, cultivation is attended to scientifically, and wheat, rye, oats and barley are there raised. South of this, rye gives place to wheat; and this predominates in England, France, and parts of Scotland, Germany, Hungary, and Western Asia. Still farther south, in Spain, Portugal, parts of France, Italy and Greece, wheat is abundant, together with rice and maize. To the East, in Persia, Northern Asia, Arabia, Nubia, Egypt and Barbary, rice, maize and millet most abound, with little of wheat. Barley, with wheat, rice

and millet, prevail near the Caspian sea, in Georgia, &c. Wheat and barley are raised in Egypt, simply by strewing the seed upon the mud after the subsidence of the Nile. Occasionally it is slightly ploughed in, but it is not again attended to till gathered. Further up the Nile, in Nubia, water-wheels are used to water the grain soils.

The grains much cultivated in the United States, Rice excepted, are rarely seen in China and Japan. Rice, indeed, constitutes the chief grain there, though wheat, and other grains might be successfully cultivated. The greatest attention is there paid to agriculture by the government. One of their Emperors was taken from the plough and placed on the throne, and most others have been distinguished agriculturists. Rice is principally cultivated in the tropical parts of Asia. In parts of India wheat is good, but it gives place to rice. In colonized parts of Africa rice and maize are chiefly cultivated, but in these last countries the arts of agriculture are comparatively wretched. In North America, wheat and maize, or Indian corn, are principally cultivated and in such quantities as to be largely exported. The highest limits for the cultivation of the cereal grains, on this continent, is in the southern parts of the Russian possessions, about latitude 58° north, where rye and barley are raised. On the eastern coast, however, the limits are no higher than about 51°.

In the lower latitudes of Mexico wheat, rye, oats, &c. are not cultivated lower than 2500 feet above the sea. In France every 540 feet of vertical elevation is equal to a recession of one degree from the equator, and in the tropics 390 feet are equal to one degree North. On the Cordilleras wheat cultivation does not generally commence lower than 4000 feet above the sea, but in Guatemala it is raised much lower. Some of the finest harvests in South America are more than 15000 feet above the sea. On more level lands irrigation is necessary, which produces good crops. Some Mexican farms, thus watered, are wonderfully productive, yielding often 50 or 60 measures of wheat for one sown. Maize is much cultivated in Mexico and yields in some valleys two hundred for one. The Indians mostly feed on this. In southern temperate latitudes the productions are similar to those of the northern. Wheat is found abundant in Chili, Buenos Ayres and Brazil. In Australia it is the principal object of culture and makes beautiful bread; and further south rye and barley are raised. In New Holland wheat is abundant.

All these grains grow abundantly in the United States; and, as improvements in the arts of culture increase, there can be no definable limits to the amount of their production. Rice is limited to the southern states, but all the others are cultivated in the other states. Wheat and maize especially abound in the western states.

The amount of products in the United States in 1842 may be gathered from the following. *Of wheat* there was raised, 102,317,340

bushels; Indian corn 441.829.246; Oats 150.883.617; Rye 22.762.-952; Buckwheat 9.483.409; Barley 3.871.622; Potatoes 135.833.381; Rice 94.007.484.

The principal producing states. Of wheat, in bushels. Ohio 25.-387.439; New-York 11.132.472; Penn. 10.887.015; Ind. 8.500.666; Tenn. 5.915.033; Ill. 5.799.038; Ken. 5.131.114, and Mich. 3.952.-389. *Of Indian Corn,* Tenn. 55.742.384; Ken. 49.053.849; Ohio 39.424.221; Ind. 38.838.275; Va. 38.101.657; Ala. 26.345.105; Ill. 25.546.728; Mo. 25.338.922; N. C. 25.332.194; Ga. 24.072.043, &c. *Of oats,* N. Y. 24.882.671; Penn. 24.120.363; Ohio 19.381.035; Va. 14.264.539, and Ill. Ken. Ten. and Ind. over eight millions each. *Of Potatoes,* N. Y. 36.880.017; Penn. 12.724.180; Me. 12.504.308; Vt. 10.941.718; N. H. 8.218.369; Ohio 7.277.309; Mass. 4.821.308. *Of Rice,* S. C. 70.265.554; Ga. 14.535.309; La. 4.000.500; N. C. 3.491.-667. *Of Rye,* Penn. 8.368.661; N. Y. 3.280.306; N. J. 2.201.592; Ken. 1.987.236; Va. 1.186.449. *Of Buckwheat,* Penn. 3.119.831; N. Y. 2.917.974; Ohio 741.230. *Of Barley,* N. Y. 2.196.081; Ohio 229.282.

The progress of improvement in these products and of agriculture is steadily progressing. Besides the amount required for home consumption, these and other agricultural productions now furnish three-fourths of all the exports of the United States. The sale and cultivation of the public lands will continue to increase greatly the amount of these products, while the late geological surveys of the states have and will continue to develope and reveal the mineral and other resources of our country. It is estimated that 83 per cent. of our population is engaged in agriculture, or depending on it for a livelihood, and that 2.700.000, or one fifth, are effective male laborers—three times more than are employed in commerce, manufactures and trade. In Great Britain nine millions are engaged in agriculture, and four in manufactures.

Last year was highly productive in all the grains. More than two-thirds of the wheat was raised in the western states, and more was sown than during any previous year. It was better in the New England states than the year before, the improvement in grain in New Hampshire, and also in Kentucky and Tennessee being estimated at 25 per cent. Next to Ohio, New-York is the greatest wheat state; and it exceeds all others in its agricultural products, generally. The wheat crop of last year in New-York and Penn. was inferior to that of the year before by 20 per cent. A new species of wheat lately introduced into this latter state from the Mediteranean is said to withstand the effects of the fly rust. This is attributed to its peculiar vigor of root. Its energy in the spring is greater than any other winter wheat; so that its hard and sapless stem in April is impenetrable to the young maggot; and, being eight or ten days earlier, it is not liable to rust.

The crop of Ohio was better, though scarcely equal to that of 1840. Of this, fourteen millions of bushels were allowed for exportation. The yield in Indiana and Illinois was estimated as high as 50 per cent. gain.

In 1840 there was shipped to Buffalo from Chicago but 20.000 bushels, while in 1841, 200.000 bushels were shipped. This, with the fact that one half more seed has been put in for this year than any year before, proves the rapid increase of this grain in Illinois. In Missouri, Arkansas, and Michigan the increase was nearly 50 per cent. The great surplus thus apparent in the western states must produce a vast revenue by exportation to Canada and to our Atlantic cities.

Calculating the grain last year to be 10 per cent. over the preceding; and if we estimate the increase in this ratio annually for ten years from 1840, the amount of wheat will be over 250 millions of bushels, or 15.000 millions of pounds as the product of 1850, which alone will support a population of 31.250.000 persons.

The aggregate amount of bread stuffs, including corn, potatoes and rice for 1842 was 717.714.691 bushels, this will allow for each person of our population, man, woman and child, about 40 bushels; or without rice, nearly 37 bushels each, or without potatoes, 35 bushels each. This shows an immense surplus, according to the usual calculations. Other articles, it will be seen, add greatly to this amount of the agricultural surplus of our country. If we estimate the annual consumption of wheat at 480 lbs. for each individual, and each bushel of wheat at 60 lbs., we have 6,139,040,400 lbs. of wheat as last year's product, which alone would support 12,789,672 persons. But rejecting rye, rice, barley, oats peas, beans, (the two last of which constitute a large proportion of the English estimates, as we shall show,) with the other American grains, and retaining two grains only, and we have near 32 bushels for each person. We may safely estimate, on the whole, the product of last year, 1842, as capable of supporting a population of more than 50 millions.

The production of wheat is said to be increased by manuring with salt-petre, and nitrate of potash, or animal substances, bones, urine and lime; and also that the best grain for bread is not the best for seed. The seed must contain the elements of wheat in due proportions; and some soils are better calculated for this than others, though others may produce better bread-grain. It is likewise said that the best seed wheat should contain much starch and little gluten, and that, consequently, it should not be raised on rich or highly manured ground, as this deranges the required proportions of starch and gluten. The selection of large full grains by means of a seive, and the sunning of these for two days, has proved effectual in resisting the effects of the Hessian fly. Further notice of seeds, with a recent discovery in pre-

paring them, so as to require no use of manures, will be found in our article on seeds.

If an improvement in the seed of our crops was made to the extent of 10 per cent. only, the increased value of the crops would be equal to $20,000,000 annually. Thus we may safely calculate on improvements and additional culture to the extent of more than 10 per cent.

Wheat has decreased in price, and the consumption for distillation has also greatly decreased within a year or two. This decrease for this purpose is equal to three millions of bushels annually in the state of New-York alone, as there has been a diminution in the manufacture of spirits of 10 millions of gallons.

Barley has not increased in the United States since 1840, far less having been manufactured into malt liquors. *Oats* are said to have been far above an average crop last year, and in New York to have gained 25 or 30 per cent. *Rye*, in the aggregate, was in advance last year. *Potatoes* were more abundant than in 1841, though probably not an average crop. *Maize*, or corn, yielded a large crop last year, in the aggregate, though not greater than the year previous. In some States it was very productive, while in others it suffered much. Mr. Young of Ken. raised 190 bushels on an acre, and his average crop for some years is said to have been 140 to the acre.

The estimated crops of the United States, as we have shown, are sufficient to support many times our population; and when our vacant lands are improved, 300 millions of people may be supported by them alone. Were the 39 millions of acres of our prairie lands cultivated, they alone would produce, at 20 bushels of wheat the acre, 780 millions of bushels of wheat, or more than 6½ times the present crop of our whole country. There were exported from the United States into Canada, in 1841, 193,137 bbls. of flour, and 212,458 bushels of wheat, (in 1840, 1,720, 659) and 90,158 bushels of maize, besides about 400,000 remaining to ship in the spring. Last year, from Cleveland alone, 380,684 bushels of wheat, 94,248 bbls. of flour, and 59,670 bushels of maize were shipped to Canada, besides 44,750 bbls. of pork, and 170,000 bushels of wheat, on hand, to ship this spring; all valued at $981,348. Wheat, corn, and other grains, flour and pork, are admitted free into Canada. A small duty has been imposed this year, which on flour, is 2s. per bbl.

The increase of last year, over 1840, was, in *Wheat* 17.494.068 bushels; in *Rye*, 4.117.385; in *Indian Corn*, 64.297.371; in *Oats*, 27.812.276; in *Buck Wheat*, 2.191.666; in *Potatoes*, 27.585.321; in *Rice*, 13.166.062 lbs. From this may be easily estimated the additional population which the increase would support, although the crop of last year is doubtless considerably below a just estimate. There was a *decrease* in *Barley* of 289.882 bushels.

Our annual productions and exportations of grains may be estimated

from the fact that in 1838 our exportation of wheat and flour was but 6,291 bushels of the former, and 448,161 barrels of the latter; while in 1790 (49 years previous) we exported 1,124,458 bushels of wheat and 724,623 barrels of flour. The average annual exportation of wheat during all that period was 209,666 bushels and of flour 877,000 barrels. It would appear further that the amount of exports of wheat, during the eight years prior to 1839, from the United States, was not equal to that exported from the single state of Pensylvania more than 100 years ago; nor, during the last 25 years (two years excepted) have the exports from the country equalled those from Pensylvania 60 years ago. The exports of flour have been less also than they were 50 years since, yet the price has increased up to 1840. The average annual inspections for the 10 years previous to 1840 were nearly alike. The number of barrels inspected in 1838 was 2,546,079, while the exportations were but 448,161 barrels, leaving for home consumption 1,097,818 barrels. But the inspections afford no just estimate of the flour manufactured.

Estimate of foreign grains.—Of the 57 millions of acres in Great Britain, 13 millions are incapable of culture, and 10 millions are waste land; the present population is therefore supported by 34 millions of acres, or twenty persons by every 34 acres. If all the waste lands were cultivated, not over 6 millions more could be supported; so that, at the present increase, the consumption will have reached the utmost production of the land in 20 years, or in 1860. One crop in seven fails in England. The crop of 1840, in the whole kingdom, was 320 millions of bushels, and in 1841, 86 millions *less*. The yearly consumption of wheat in Great Britain is 104 millions. In 1841, 21,604,840 bushels were imported into England, of which, 2,528,600 were from the United States; but in 1840, 6,831,000 bushels were from the United States. The exports of wheat and flour from Canada to Great Britain, in 1835, were 88,695 cwt. of wheat and 48,811 of flour. From 1828 to 1839, Great Britain raised enough for her consumption only 4 years out of the 12, and in two of every three years she imports 10 per cent. of all her home consumption. Great Britain imported in 1840, Wheat, of bushels, 9.931.688; beans, 514.864; peas, 238.784; Rice, 265.642 lbs., and wheat flour, 456.74 cwt.

The English include the products of Peas and Beans in their estimates of grains; so that, of 44 millions of bushels estimated as the annual consumption of the kingdom some years since, 14,880,000 bushels were of peas and beans; and the proportion of wheat was but 12 millions. Half of the grain crop is said not to be brought to market. In 1831 the importation of grain was 28,000,000 of bushels, about a seventh part of the produce brought to market. In 1835 the quantity of grain sent from Ireland to Great Britain was 21,352,104 bushels; 5,294,208 of which were wheat, and 14,581,648 oats. It is estimated

that 9 millions of people in England are fed on wheat, 1,500,000 on barley, 4,500 on oats, 500,000 on rye, and 500,000 on peas and beans. Thus the proportion to each person would be of wheat 8 bushels; barley 10 bushels; oats 10 bushels, or peas and beans 8 bushels. The consumption of oats is thought to be underrated, there being more fed on them by the diffrence of 18 millions of bushels consumed; and those fed on peas and beans must also, we think, be similarly underestimated, as seen above.

The quantity of grain raised.—This in France, annually, is estimated at 497,769,640 bushels. 16 per cent. of this is consumed in seed, 19 per cent. in feeding animals, and 2 per cent. in distilleries and breweries. This and other facts we shall hereafter mention, show that not less malt liquors but ardent spirits, are consumed in greater proportions in France than in England and Ireland; probably from 50 to 100 per cent. less, and with the exception of wines, 50 per cent. The wheat grown annually in France is about 176 millions of bushels; the proportion of grain, consumed therefore, by each person is about 10 bushels, or two more than in England; and the whole amount of grain raised is about equal to the consumption; but when deficient it is imported from the Black Sea. In Hungary 105 millions of bushels of grain are raised, which, supposing none to be consumed in seed or distillation, afford but 6¾ bushels for each of 13 millions of inhabitants.

The annual exportations, for 25 years, from Dantzic, the depot for the productions of Poland, are 1,602,640 bushels of wheat, and 540-088 bushels of Rye. But, in 1830, there were exported from that place 3,232,000 bushels. This port and Hamburgh are the two great grain markets of the North of Europe. Spain exports wheat largely to Great Britain; the amount in 1831 was 1,264,000 bushels. The amount exported from Odessa, on the Black Sea, the only grain-port in the south of Russia, is annually about 3,421,976 bushels. Little if any is exported from Sicily, though once the principal granary of Rome.

WHEAT.—(*Triticum*) c. 3, o. 2, Gramineæ, sp 16-28. Ds. A. 4 ft. This, of all the genus graminæ and of the cereal grains, is universally esteemed as the most valuable, although the comparative cost of its production induces less attention to its cultivation in some countries than to other grains. It is especially remarkable that it sustains the extremes of heat and cold, and it is therefore one of the greatest gifts of nature. It is now the chief food of the people of Ameriea; and, as we have shown, is exported in large quantities, both in grain and flour. There are several species and a still greater number of varieties of this grain, most of which last are attributable to differences in climate and modes of culture. All kinds are however distinguished in this country by the season in which they are sown, as *Spring* or *Summer Wheat*, and *Winter Wheat*.

The species of wheat are 1st, T. *Æstivum*, summer or spring wheat. 2, T. *Hybernum*, winter or lamas wheat, (var. 1 red, 2 white, both without awns, 3 red, 4 white, both with awns) 3, T. *Compositum*, Many spiked wheat; 4, T. *Turgidum*, Duck Bill, Grey Pollard or cone wheat; 5, T. *Polonium;* Polish wheat; 6, T. *Spelta;* 7, T. *Monococum*. The remaining species of the genus are called wheat grasses and are of no use in agriculture. Winter wheat is red and white, the grain of the red is small; the white is chiefly cultivated here of which there are two kinds, the best is the *thin chaffed*.



The first, or Spring Wheat, as shown in the cut, is supposed to be a native of Siberia: it is not so hardy as the second, and it has a thinner and less erect stem, more slender ear, with a longer beard or awn; its grain is smaller and its product less. The reason for its culture is the security it affords against a cold and wet spring. It is sown in April or May. Its nutritive properties are not equal to winter wheat, by a difference of 1½ per cent., and its gluten is as 19 to 24.



Winter Wheat, or *Lamas*, as it is called in England, is sown in Autumn; it stands through the winter and ripens during the following summer. Its varieties are distinguished by a difference of color in the tunic enclosing the grain. The colors are commonly *red* and *white*. The red is most hardy, but not so productive as white, nor is the flour of so good a quality. It is beard less.



Duck Bill, or *conical*, wheat is another variety, but it is little cultivated.



Egyptian, many spiked wheat, or "corn of abundance," is mostly cultivated in Egypt and Italy; it resembles, in its habits, the spring wheat. Its ear is bearded, and it sustains great heat and drought.



Polish wheat is some cultivated in parts of Europe.



Spelt wheat, or T. spelta, is supposed to be the *triticum* of the Romans, and the *zea* of the Greeks. It appears to be a distinct species, more hardy than common wheat. It continues to be cultivated in the South of Europe, and requires less culture, and it may be raised on coarser soils than our wheat. There are two varieties, the *bearded* and *beardless*. The latteris larger, but has few grains, part of the flowers proving barren. It is sown in spring and is strong, the stems being nearly solid; the flour is dry.



One seeded wheat, "or St. Peter's corn," is another variety, the smallest in stem and leaves of any; the spike contains but one row of grains. It is mostly raised in parts of Switzerland, and is better for gruel than for bread. The ear is four sided and very regular.



The seven eared wheat is raised in the most warm parts of the world and is the kind formerly raised in Egypt and Syria; it is often mentioned in the Bible by the name of *corn*. Its stem is filled with pith and is thereby able to sustain the weight of the ears.

The mode of propagating wheat is in two ways; the most ancient as well as the most common is to scatter the seed with the hand, or *broad cast*, the other is to deposite it in holes formed in straight furrows, at regular intervals, which is called *drilling*. Various methods have been invented, or suggested, for sowing, but the first is the common mode here. The mode of germination has been elsewhere explained, but it is not unworthy of remark that it is wonderful how the little germ of wheat produces, not only a plant, but one plant after another, so that in a few seasons the minute germ affords food for a whole nation of people. The number of stalks from each seed depends on local causes. The multiplication of these is called *tillering*. They spring from the young sprouts, but are often attacked at the roots by the insect *musea pumilionis* which deposits its eggs in the core of the plumule. But their injury is more than repaid by the plant sending out, in consequence, new shoots from the knots, which fix it more firmly and produce many stems and ears, instead of but one. A plant of barley has been known to produce 249 stalks and 18.000 grains, and in another case 100 ears, each with from sixty to seventy grains.

The produce of wheat varies with the soil, season and culture. An

acre of good ground generally produced in England, in the thirteenth century, only about twelve bushels of wheat and in the sixteenth from sixteen to twenty bushels, and barley thirty-six bushels. Fifty years ago the produce was twenty-two and a half bushels the acre. Since this the amount has increased as all productions do increase by the advance of people in knowledge and industry.

The crops in the United States show an average vastly greater than this, and probably greater than in any other part of the world. Instances of extraordinary production are frequent, but the medium may be estimated at about forty bushels the acre. The aggregate product of the United States in 1842 was 102.317.540 bushels, being an increase of 10 per cent., or 10.674.683 bushels on the previous year.

When a distinguished Roman farmer was indicted and brought before an assembly of the people for sorcery in having produced larger crops from a small spot of land than his neighbors from their extensive fields, he answered the charge by producing his more efficient instruments of husbandry, his vigorous oxen and his hale young daughter, and said "these, Romans, are my instruments of witchcraft, but, I cannot show you my labors, sweats, and anxious cares."

The principle casualties to which wheat is liable are *blight, smut* and *mildew*. By the first the fibres are contracted and enfeebled, and the grain is deprived of sufficient nourishment. It was considered among the Greeks and Romans a sign of the wrath of the offended deities, and no remedy was, of course, resorted to. By the second the stem and ear are affected, and by the third the grains are filled with a dark powder. But the two last are confounded, or they may be referred to the same disorder at different periods of the plant's growth. Three causes are assigned for these disorders; viz. cold and frosty winds, sultry and pestilential vapors and a parasitical fungus. The first stops the current of juices, the leaves die and the vessels of the plant become filled with insects. The second occurs after the growth of the grain and commonly after heavy rains. Its effects are called *burnt grain* and were thought contagious. The grain of mildewed plants are said to answer for seed. Smut consists in the conversion of the farina of the grain into a black sooty and offensive powder which, under the microscope, shows millions of minute globules. It has been attributed to a diseased state of the seed, but is now known to be a fungus, (see *blight*.)

BLIGHT—*pucinia*—c. 24, o. 9, T, 4, sp 30. P. graminis is the well known blight, a minute parasitic fungus. In attacking the stem or leaves of the grain-plants, or corn, it first has the appearance of orange colored streaks, which afterwards take a deep brown color. The plants attack the parenchyma just below the pores of the cuticle. Each is so small that any pore on a straw will produce from 20 to 40 fungi and each of these will doubtless produce at least 100 reproduc-

tive particles; so that the progeny of a single pore will be sufficient to infect a whole plant. The period of generation is thought not to exceed a week; and as the particles are very light they are wafted into the air in clouds of animated dust, carrying disease into all the neighborhood. Numerous illustrations of the forms of this plant, and the progress of its development, have been published, which space denies us the liberty to notice; but, with a strong magnifying glass, the whole structure and varied appearances may be seen. The fungus insinuates itself into the open pores and stomates, where they germinate and push their minute roots into the cellular texture beyond the bark, where they draw nourishment by intercepting the flowing sap necessary for the growth of the grain. In some cases the corn has been so completely robbed of its flour by the fungus, that hardly an atom of it remains in the grain; and bran is alone the product. Every species of corn is subject to the blight, but spring corn is less damaged by it than winter. Bearded wheat, with the straw full of pith, is less subject to blight than Lammas, which ripens a week later. It is thought probable that the leaf is first infected before the corn shoots up into straw, when it is of an orange color. It has long been believed by farmers, though doubted by botanists, that wheat near barbery bushes seldom escapes blight, and many examples would appear to confirm the opinion. This has been attributed to the farina of the flowers of the barbery. The leaves of the barbery, it is well-known are very subject to the attack of a yellow parasitic fungus, larger, but otherwise not different from the rust in corn. Whatever the cause of the diffusion and propagation of this fungus may be, recent observations have thrown much light on its nature and habits, so that we may hope that means may soon be discovered by which to prevent its ravages.

The average weight of a bushel of wheat is about 60 lbs., seldom less than 56 or over 62. The average weight-yield, on being ground, is 47 lbs. of bread flour, 4½ fine pollard, 4 oz. coarse pollard, 2½ oz. bran, loss 2 oz.—total 60 lbs. 14 lbs. of American flour make 21½ lbs. of bread, the same of best English flour make but 18½ lbs.

The average price, per bushel, of wheat, in England, from 1834 to 1840 was—in 1834, $1.26½; in 1835 $1.20; in 1836 $1.32½; in 1837 $1.54½; in 1838 $1.72; in 1839 $2.01; in 1840 $1.91; showing a rapid increase, except in 1840. The average price of flour there from Dantzic is $7 per barrel. The annual consumption of all grains in Great Britain is estimated at 416.000.000 of bushels.

All Europe it is said could not supply England with more than 18.000.000 of bushels, yet she imported in 1841, 21.604.840 bushels; showing her dependence on America for this grain. Ohio alone yields one-fourth more than the whole of that amount. The duty on imported grains, according to the sliding scale, is, when the price is under $1.53

per bushel, 60 cts.; and 3 cts. less per bushel for every increase of 3 cts. on the price up to $2.19, and over 1 when the duty is 3 cts. per bushel. On flour, for every barrel of 196 lbs., the duty is equal to that on 38½ gals. of wheat. The duty on wheat from her colonies is 15 cts. per bushel, when the price is under $1.51; under $1.54, 10 cts.; under $1.57, 8¾ cts.; under $1.59¾, 5¼ cts., and upwards 3¾ cts.

Wheat yields 955 parts of nutritive matter. According to Davy, 14 lbs. yield 13 lbs. of flour, the same of barley 12 lbs., and same of oats 8 lbs. 1000 parts yield 955 soluble parts, of barley 920, and of oats 743; the gluten of wheat being 90, of barley 60, and of oats 87.

Starch is mostly obtained from the flour by washing it in cold water. Its constituents are carbon, 43.55; oxygen, 49.68, and hydrogen, 6.77- in 100. The *bran* is the husks, separated by grinding; it is used as food for cattle, and for washing the hands in lieu of soap. The straw, cut fine and mixed with water, is used as provender and for the litter of cattle, for thatching, filing beds, making paper, for ropes, chairs, etc.; and when bleached with sulphur and split, is plated for hats, bonnets, etc. The value of straw bonnets made in the United States in 1840, was $1.476.505—persons employed, 20.176; capital invested $485.300. Leghorn hats are made of a bearded variety of wheat, 18 inches high, resembling rye. It grows on sandy soil on the Arno, between Leghorn and Florence. It is pulled when green and bleached like flax on the gravelly bed of the river. The straw is not split, as here, which renders the plait tougher and more durable.

American wheat is of 2 kinds, *smooth* and *bearded;* the first generally produces here the finest flour, and the second the largest crops, with a stiffer stem and less liability to disease. The first requires a dry mellow soil, and the second new, stiff and moist soil. Of the *smooth* kind the *white* variety is best for flour, and the *red* for amount of product. An Italian spring wheat, lately introduced, is said to be of a superior kind. Whittington's new prize wheat, also recently introduced, from 2 stalks from Switzerland, produces from 20 to 30 ears on each plant; the ear is full, the kernel white, and it grows equally well on sandy or clayey soil. 12 bushels on 6 acres have produced 350 bushels. The *new Mediterranean Wheat* we have mentioned before. *The solid-stem wheat,* lately from Asia, resists the fly well and yields a large and heavy grain. The *Trigorica wheat* is said to yield 400 fold and to have much nutriment. The Lamas wheat of England is here generally red. The *Red-chaff wheat,* a variety which originated on the shores of Maryland, and now widely cultivated, yields a white and superior flour, though later than other varieties and liable to mildew. The *yellow-bearded wheat,* originating on Long Island, N. Y., yields and stands the winter well; it gives a dark flour, and is liable to smut. *Red-chaff wheat,* of Virginian origin is strong and stout—produces well, makes white flour, and stands the winter well. *Early*

Virginia Wheat is 2 weeks earlier than other kinds, and yields well. *Jones's Wheat* of Pensylvania produces excellent white flour, stands the winter well and resists the fly, but yields least of any. *Spelt* is cultivated here and yields a brown but wholesome flour. We are indebted to other countries for the grains, originally, Indian corn excepted, though we have produced many inestimable varieties.



Rye.—*Secale Cereale*, C. 3, O. 2, Graminæ, sp. 24. Ds. A. 3 ft. This grain is considered next in value to wheat, in temperate climates. Its appearance in the grain and in growing differs little from wheat. It is supposed to have been brought originally from the Levant, though it has been cultivated in Europe from time immemorial. It has been the least changed by cultivation of all domestic plants, nor has it been found wild. It is much more common on the continent than wheat, it being a more certain crop and requiring less manure and culture. In Russia and Germany it is the bread corn; it is also considerably grown in the United States, but much less in England. It sustains cold climates and grows in a greater variety of soils than wheat, and arrives at maturity sooner; it also has a better flavor, though it is not so nutritious as wheat; still it is much used for bread. A great part of this grain has been used heretofore for distilling spirits. The straw is more durable than that of wheat and is used for thatching, laying bricks, and other purposes in the arts. The flour is much used mixed with that of wheat, the bread being cheaper and by some preferred. Two centuries ago it furnished all the bread consumed by the laboring classes in England. As food for cattle it is sown in November and eaten early in spring. It is now much cultivated for an acid procured from it and employed by Tanners in a process called *raising;* by which the pores of leather are opened to receive tannin the more readily. Parched and ground Rye is now much used as a substitute for coffee, both here and in Europe.

There are four species of rye, but the *secale cereale* is the only one cultivated in this country. There are two varieties of this species, the *winter* and *spring* rye. When sown with wheat the harvest is termed *meslin, mung* corn, or *monk corn*, from its having been eaten in monasteries. Next to wheat, it contains more gluten than any cereal grain. Five parts of every 100 consists of ready formed saccharine matter, and hence it is easily converted into malt beer and ardent spirit, though much inferior for the first purpose than barley. It yields 792 parts of soluble matter, of which 645 are mucilage, 190 gluten and 38 sugar—1000. It contains from 70 to 79 per cent. of nutritive matter; that of wheat being 95 with 19 parts of gluten. It passes rapidly from the vinous to the acetous fermentation. All the grain spirit of Germany, known as *Holland, Geneva, &c.* is made by the mixture and fermentation of unmalted rye mixed with barley malt, in the

proportion of two parts by weight of the former to one of the latter, and flavored with juniper. Some peculiar process however is used by Dutch distillers, as all attempts to make the same quality here have failed. The common bread of the people about the Baltic is made of rye, which is largely exported from Prussian ports. Of the 650.000 bushels exported from Dantzic in 1830, (which is about the annual export,) three-eights was taken to Holland for distillation. A million of bushels of rye and 200.000 of wheat are exported from Archangel annually and 400.000 of the first from Riga. In 1829 a million of bushels were exported from St. Petersburgh. The crop of the United States last year, 1842, was 22.762.952 bushels; of which Pennsylvania and New-York were the greatest producers. Rye cakes are the principal food of the peasants in Sweden. These are baked twice a year and are therefore as hard as a board. Rye is sown mixed with barley in Lapland and with wheat in France, and thus mixed, is made into bread.

A disease attacks rye which renders it noxious and even poisonous. It is thus called *horned-rye*, or *ergot*, the grain resembling a cock's spur. A wet spring and hot summer are the attendants of this disease. It is an excrescence or irregular vegetation, 1½ inches long, springing from between the grain and leaf. Bread made of rye thus diseased has a nauseous acrid taste and produces spasms and gangreens. Many fatal epidemics have widely prevailed in Europe where this grain is cultivated. The first symptoms are apparent drunkenness, after which the toes mortify and fall off and then the disease extends upwards to the trunk, even after amputating the limbs. Insects, poultry and other animals are also fatally affected by it; even flies that light upon it die with convulsions. But, singular as it may seem, this poison is admitted into practice as a medicine. Rye is apt to be confounded with rye grass and by some with rag-grass.

MAIZE or Indian Corn, *zea mays*, C. 2, O. 3, Graminæ, sp. 2, Ds. A. 3-12 ft. The name *zea* implies *to live*. There are numerous varieties of this important plant, but only two species; these differ in time of growth, quality, etc. but the varieties differ, from peculiarities of culture, soil and climate. Maize is cultivated in a wider range of climate than most other grains; and, next to wheat, is the most important grain in utility in this country. It is evidently more stimulating than any other of the cereal grains; and wherever Indian corn forms the principal food, the people are strong and hardy. It is convertible into human food in a greater variety of forms than any other grain, and no crop is more beneficial to the American farmer. No crop returns more to the soil, and none is better fitted perhaps for fattening domestic animals. A religious reputation is attached to the Valparaiso maize, from its splitting, when roasted, into the form of a cross; and it has been denominated here, in view of its importance, a *magnum Dei donum*. Two crops are often raised annually in the western states.

The form and growth of Indian corn are too well known to need description. Some of the varieties are suitable only for the long summers of the southern states. The top produces a bunch of male flowers called the *tassel*. Each plant bears one or more spikes or *ears*—generally 3 and sometimes 7, enveloped in a sheath of husks. The eyes, or germs of the seed are arranged in radical lines on the *cobb*, each sending out a filament of *silk*. These are the *stigma* which hang out to receive the farina which drops from the tassel or flower, and without which the ear would produce no seed. When this is effected, both wither. The color of the seed varies even in the same ear.

The native country of this plant is undoubtedly America. The Indians throughout this continent were found, on its discovery, engaged in cultivating this grain, and it is now found wild in Paraguay; so that 250 years ago, this important plant was known only to the American Indians. As food, it is extensively used throughout this country and in South America. In Mexico it is the principle support of the people, and in Africa its consumption is equal to that of rice.

A prejudice has existed against this grain, but obviously from a national feeling well known to be characteristic of the people whence it originated. But it has been justly said by an English writer that no argument, as to the quality of particular kinds of food, can be based on individual or national liking or disliking. This may be so with respect to other people, but it is not applicable to the source of the sentiment, for the taste of no people is more questionable on this subject —the *sentiment* to the contrary notwithstanding—than that of the English.

The useful qualities of maize are numerous. Coarsly ground and boiled it forms the favorite old fashioned *hominy* of the southern states; and, when finely ground and mixed with water or milk, the *mush* of Pennsylvania and the *hasty pudding* of the eastern states; and also when hulled, the *samp* so generally admired with milk, or the *johnny-cake* much eaten by the negroes of the south; and, in the early history of our country, by the people generally, as was the acorn, or hog nut, some centuries since by the people of England. Indian meal is still much used as a favorite, sweetly flavored and wholesome bread; and in puddings, well prepared, it is not excelled by the flour of any other grain. Mixed with wheat flour it makes a bread decidedly more palatable and wholesome than wheat flour alone. It does not lie within the stomach a heavy mass, affected with difficulty by the gastric juice, as with the greater portion of fresh baker's bread, but is always light, stimulating and well flavored.

White corn is said to be the best for bread, and the yellow best for cattle. Sweet corn is best for early boiling and also for fodder. Musty corn is cured by turning upon it twice the quantity of boiling water, letting it remain till cold; musty wheat is cured in the same manner.

Domestic animals of all kinds are extremely fond of it; and, as is well known, readily fatten upon it, their flesh being at the same time remarkable for its firmness. Both men and horses feeding upon it are very hardy and perform more labor than when feeding on most other kinds of food. The cobbs should be ground with the corn when designed for cattle, the advantage being as 3¼ in 13. Maize when fed to horses should be soaked 12 hours in water, it being then more easily mashed and more nourishing. The wet meal fed to chickens is the very best and most nutritive food, and the grain is equally so to grown fowls.

Maize eaten in various ways, is wholesome and delicate before the harvest. The tender green ears, stripped of their leaves, are roasted before a quick fire till brown, and the grain eaten with salt and butter. When riper, the ears are boiled, either with or without the leaves, and eaten as above, or cut off and eaten with kidney beans. The tender grains dried may be kept through the year and eaten with beans, also alone, if soaked some hours in water and boiled. When ripe and hard, it may be soaked during the night in a lye of ashes, then pounded in a mortar, by which the skin is peeled off and the farinaceous part is left whole. This on boiling, swells into a white soft pulp, which is eaten with milk or with butter and sugar. Ground loosely into pieces of the size of rice, winnowed and boiled, it is eaten with fowls, etc. Finely ground and boiled, it is eaten with milk, or as puddings, or baked before the fire on flat erect pieces of iron, as a hasty bread cake or "Johnny cake." It is also blended in soups or broths. The grains placed in an iron pot filled with sand and heated hot, burst on stirring the sand, and are then large and white. The whole is then turned into a wire seive, the corn separated, and the sand returned to the pot and the process repeated, if desired. This parched corn is then powdered in mortars or eaten otherways. 6 or 8 oz. mixed with water supports a person a day. Our Indians, and the people of the East, travel mostly with this light and nutritious food.

An oil, almost equal to Olive oil, is extracted from the kernel, which promises to be of much importance, both in the arts and for culinary purposes. It is now obtained in considerable quantities at the West.

In Mexico, corn is often sowed thick, and the small stalks are cut and served like asparagus, as a dessert. There is said to be a disease of this grain, resembling the *ergot* of rye, though less serious. All eating of it shed their teeth and hair, and quadrupeds their hoofs; fowls also, eating of it lay their eggs without shells. Administered medicinally, it is also said to be more powerful than the ergot of rye. Maize, in the Levant, is called *Turkey corn;* indeed it might be called the corn of every country, the latitude of which does not exceed 46°; for, next to rice, perhaps, it supplies with food the greatest number of the human race. It is the handsomest and largest of all

the grasses used for food, having the appearance every where of a tropical plant. In Italy the flour is prepared for many dishes, all of which are called *polenta*. All attempts to extend its cultivation in England have failed, as the climate is too cold and moist, generally. In Mexico a saccharine beverage is prepared from it with much address by the Indians, and they thus used it when conquered by Cortez.

The American Indian Corn is the largest grain of this kind known. Its stalk often attains at the West to the height of 12 and even 20 feet, and yields very abundantly, as we have before shown. The average crop of last year in the United States was 441.829.246 bushels. In some of the provinces of Mexico, at an elevation of 6 or 7000 feet, which nearly corresponds with our temperate climate, it also yields even 800 for 1. This variety rarely comes to maturity in extreme northern climates, nor can it be relied on, it is thought, as a safe crop in any part of Europe. Manures are rarely used in our Western States in raising this grain, nor so much in the Eastern States, as with some others. The 12 rowed corn is said to be best for planting and also for the amount of product. Buel said that it is earlier than any other field variety, and that two bushels of ears yield 5 pecks of shelled grain, weighing 62 lbs. the bushel. Others say the eight-rowed proves the most valuable, though it may be hard to make a superficial observer believe it.

Three varieties are best for green corn, which by a little pains may be picked four weeks earlier than field corn, viz. :—*Golden Soix, Flour Corn* or York Cheat, and *Sweet corn.* The first is the earliest and is well flavored; the second is white and soft, and lasts till sweet corn is fit for use. It was called *cheat* from its having been mixed when ground with flour. And the third is superior to the rest for boiling, sweetness, etc.

The Aborigines of our country were guided in the time of sowing maize by the appearance of some particular bud, or certain fish within their waters. They shelled it from the cobb soon after harvesting, dried it thoroughly in the sun and then buried it in the earth, surrounded by mats of dried grass. They had a tradition respecting this grain which was related by a Susquehannah Chief, and recorded by Dr. Franklin. "In the beginning," said this child of nature, "our fathers had only the flesh of animals to subsist on, and if their hunting was unsuccessful, they were starving. Two of our young hunters having killed a deer, made a fire to broil a part of it, when they were about to satisfy their hunger, they beheld a beautiful young woman descend from the clouds and seat herself on that hill, which you see yonder among the blue mountains. They said to each other, it is a spirit that has perhaps smelled our broiling venison and wishes to eat of it; let us offer some to her. They presented her with the tongue. She was pleased with it and said, 'your kindness shall be rewarded;

come to this place after 13 moons and you shall find something that will be of great benefit in nourishing you and your children to the latest generation.' They did so, and to their great surprise, found plants they had never seen before, but which, from that ancient time, have been constantly cultivated among us, to our great advantage. Where her right hand touched the ground, they found maize; where her left had touched it they found kidney beans; and where she had seated herself they found tobacco."

The second variety of maize produces white grains, and this is the kind chiefly cultivated in the South of Europe, where it is only 6 or 7 feet high, and the ear 6 or 7 inches long. Neither of these varieties come to maturity in England, except in very favorable seasons. The third variety has both white and yellow seeds, and is even smaller than the last, rarely exceeding 4 feet in height, and the ears 4 or 5 inches in length. It is cultivated in this country and in the middle parts of Europe. In Germany it is used in the preparation of beer.

It is common, in cultivating corn in some places, to remove the blades and the top and tassel, as soon as the farina or polen, has been deposited on the ears, in order to admit the sun and to afford more nutriment to the grain. Parts removed are stacked, making good food for cattle and sheep in the spring, and being very sweet. The ears are either picked on the field or the stalk is cut and the whole removed, when the stalks are fed to cattle, as they abound with saccharine matter. Latterly, however, the stalks have been discovered to be still more valuable for making sugar. The leaves make a good *wrapping paper*, and the husks a good *writing paper*.

Broom corn is another species, which, with us, is very valuable for making floor brooms. It is much cultivated on the Connecticut river, in Mass. The amount produced on the acre is from 800 to 1000 lbs., beside 60 or 70 bushels of seed. The brush is estimated to be worth 4 or 5 cts. the lb. and sometimes 10 or 12 cts. The seed on an acre, at 33 cts. the bushel, is said to be equal to a crop of oats. 1.300 acres of this plant are cultivated in the town of North Hampton and vicinity, the brush and seed of which is valued at $100.000 annually. The adjoining town of Hadley manufactures brooms to the value of $160.000 annually. One person it is said makes 80.000 brooms a-year. The process of cultivation is like that of the Indian corn.

Corn Sugar.—Considerable attention has been attracted within the last year to experiments made to obtain sugar from corn stalks. Thus far the success indicates the most important results. An excellent syrup, or molasses, has been obtained, and the sugur we have seen was certainly of a very superior quality. Mr. Webb, of Wilmington, (Del.) has introduced this discovery to notice; and he affirms that his "anticipations have been more and more confirmed by every succeeding step in the investigation." At present it appears that there is "no

deficiency in the corn," and that the only difficulty is in crystallizing the sugar. Experiments evidently "show the superiority of the corn stalk over the cane for making sugar." It has been shown that the juice of the corn stalk is two tenths stronger than the juice of the sugar cane. From many experiments made at the west, it has been estimated that from 600 to 1,000 pounds of sugar may be obtained from the acre, and that three quarts of juice will yield saccharine matter equal to one pound of sugar, or 8 or 9 gallons will make 10 of thick molasses. These trials are to be repeated with the assurance that "in a few years the corn sugar will become an article of export and of great value to the west." Sugar has been made of the water in which the ears of corn have been boiled; and it is consequently inferred that the cobb also contains much saccharine matter. Large stalks yield most juice in proportion to their size; and the corn, it is said, should therefore be grown in drills: the leaves are stripped off before the stalks are cut. Experiments have been made at the south with prospects not less flattering than the above. Having sugar mills and every convenience, it is thought that the corn stalk will there be preferred to the cane. A saturated solution of the cane juice contains 5 parts of sugar and 3 of water. An acre yields at most but 700 gals. of cane juice, of which 122 lbs. of sugar are made, showing an equal, if not superior average quantity from the corn stalk. The juice fermented and distilled yields an excellent spirit. The Mexicans, Cortez says, "made honey from the stalks of maize as sweet as sugar cane," and also "sugar; and this sugar they sell," they also prepared a fermented liquor from it. This they continue to make and also several beverages resembling beer, cider, &c. which, in some places, are articles of commerce.



RICE.—Oryza, (*Sativa,*) C 6, O 2, Graminæ, sp.1,Ds. A. 1-6 ft. This is an annual grain well known in this country. It was long cultivated in the East before it was introduced into Egypt and Greece. It came to South Carolina in 1697, a small bag of it having been sent as a present from Mr. Dubois, Treasurer of the East India Company to a merchant in Charleston; it is also said that 60 tons were exported to England in 1798. But the author of a work published in 1701, says, "a brigantine from the island of Madagascar put in at Carolina, having a little seed rice left, which the captain gave to a gentleman by the name of Woodbury. From part of this he had a very good crop, but was ignorant, for some years, how to clean it. It was soon dispersed over the province, and, by frequent experiments and observations, they soon found out ways of producing and manufacturing it to so great a perfection that it is thought to exceed any other in value. The writer of this hath seen the said captain in Carolina, where he re-

ceived a handsome gratuity from the gentlemen of that country in acknowledgement of the service he had done the Province. It is likewise reported that Mr. Dubois, then Treasurer of the East India Company, did send to that country a small bag of seed rice some short time after." To this has been attributed the fact of having two kinds there. The cultivation of rice in this country is confined to the southern states, where its increase has been wonderful and from whence great quantities are now shipped to British and other ports. Its quality is much superior to that of India, whence it came originally, or to any other known. The destiny of whole nations of people has been changed by the cultivation of rice; hundreds of millions depend upon its annual crops. The Chinese and Hindoos owe their civilization to it. The former obtain two crops a year from the same ground. They cultivate it even upon rafts covered with soil. Rice, in fine, constitutes the food of the largest portion of the human race, but where it is mostly cultivated in the East the people are in the lowest state, and life is most precarious. They have no inferior food to fall back upon. Rice seeds direct from India do not ripen in Germany. The mountain rice is cultivated in Hungary, like barley or summer wheat. Rice is superior, as an article of diet, to almost any other vegetable in warm climates, but is not so well calculated for the constitution of people of the north.

There are four varieties though but one species of rice, but these are the result of difference of soil, culture and climate. The stem is commonly from 1 to 6 feet high, resembling wheat; the flowers also resemble those of oats. Each grain is terminated by a beard and is enclosed in a rough yellow husk, the whole resembling barley. Its yield is about six times as much as wheat on the same space of land. A kind grows near the snows of the Himalaya mountains which, it is thought, may be made valuable to the American cultivator. The farina of rice is almost entirely composed of starch, with little or no gluten and without saccharine matter. The outer husk adheres so closely that the grain has to be passed between mill stones to remove it. Swamps occasioned by the tide and those caused by the floodings of the rivers are best suited for the production of rice in this country. It is raised with very little labor. It is not much used as a bread grain here, but boiled, it is the chief food of the slaves of the southern states. Mixed with wheat flour it makes a fine bread. For puddings it is greatly used throughout the country. A pound slowly boiled yields, it is said, 4 pounds of nutritive food. Where rice is the chief food of the people, dearths are not uncommon, from a failure of the usual supply of rain. Here we are most happily guarded against dearths or famines by the diversity of our crops. Articles of food which may have been at any time luxuries have been by their naturilization brought within the reach of all; so that in unfavorable seasons we are now supplied with articles on which we can always fall back.

The Common Rice is a marsh plant, so that if the soil becomes dry before its maturity, it withers. This grows most strongly, and upon its peculiar soil, no other kind, or perhaps any other plant, can be advantageously cultivated. Early rice is also a marsh plant, but is of a smaller size than the other. It however comes to maturity two months earlier, this requiring but four, while the other requires six months to become perfected. *Mountain Rice* is cultivated on the sides of hills, but is mostly confined to eastern countries. After many experiments it does not seem susceptible of cultivation on low lands. *Clammy rice* grows both on wet and dry soils; and the period of its maturity is between the early and common rice.

The culture of rice in America extends from the Gulf of Mexico to Virginia, but grows most abundantly in Georgia and South Carolina. The entries for home consumption in Great Britain in 1830 were 153. 652 cwt. of cleaned, and 189.249 cwt. of rough grain, but these were less in subsequent years. Of 76 millions lbs. raised in the U. S. in 1840, 60 millions were cultivated in Georgia, and 12 millions in South Carolina. Of this product the value of exports was $1.942.076. The Carolina rice is prefered to any other varicty. The aggregate crop in the U. S. in 1842 was 94.207.484 lbs.

Wild rice, zizania, aquatica, abounds on the margins of the northern lakes and upper branches of the Mississippi, and also as far south as lat. 32. It some resembles oats. Water fowls fatten on it. The Indians of the north, traders and hunters feed much upon it. It rises in water 6 feet deep and appears the same distance above it. The grain is as white as the common rice, and puddings are made of it which taste like those made of sago.

The mode of cultivating rice is by sowing it in straight rows, in trenches eighteen inches apart. This is generally completed by the middle of March, when the land is flooded several inches deep for some days, by water before kept back by flood gates. This promotes the germination of the seed. After the withdrawal of the water for about four weeks, it is again let on when the sprout is three or four inches high, by which the weeds are destroyed. It is then hoed several times until the middle of July, when the water is again admitted and is allowed to remain until the grain is ripened. The harvest commences about the end of August. The rice is reaped with a sickle by male and gathered and bound by female negroes. Owing to the moisture of the soil and the heat of the sun at this time, this operation is a very unhealthy one.

In Italy and Spain water is allowed to stand on the soil during the growth of the rice, and three crops are successively taken from the soil, after which it is manured and other crops are substituted. In Ceylon the rice is cultivated on terraces; the water is brought from a distance to flood successively each terrace, according to the relative

states of the growth of the rice. In China the rice is placed in baskets immersed in water several days. The ground is thoroughly soaked, then ploughed, afterwards covered with water and then harrowed. The plant appears above ground in one or two days after the seed is sown. When the plants have acquired a little strength they are sprinkled over with lime water to destroy insects. After this the plants are pulled up and speedily planted in tufts in prepared fields, which are frequently watered and weeded; and the grain is then gathered and prepared as in this country. In Hindostan the mode of culture is similar to that of China, but wild hogs destroy much of the crops during the night time.

The Rice bird, in America and the West Indies is very destructive. This bird is said to be the same as our Bob Lincoln. These birds first attack the earlier crops of Cuba, and when the grain there becomes too hard they proceed in immense flocks to our southern fields, where, from being very lean, they become excessively fat in the three weeks of their visit. They then subsist on insects and green plants till the maize begins to form its grains, when they attack that with like avidity and effect. These birds are found in extensive flocks in the New England states in spring and summer, where they breed, leaving with their young in season for the rice grains in Cuba, all the females going first and alone with their young and the melodious males following. Their flesh is considered a great delicacy.

The uses of rice are various. In India and China it is more the staple article of consumption than any other in other parts of the world. There and in Africa little other preparation than boiling is made of it; while in this and some other countries it is commonly prepared for the table with eggs, milk, sugar, etc. Fermented bread may be made of rice by reducing it to powder in a mill or by pounding it in a mortar, after soaking it some hours in nearly boiling water. The flour is then passed through a seive and placed in a trough with water, made glutenous by boiling rice in it for some time; add salt and the proper leaven or yeast, and kneed the whole intimately together. The dough is then covered with warm cloths and left to rise. Becoming softer by rising, it is placed in pans of the size of the loaves required, is covered with sheets of paper and set in the oven; in a little time the pans may be reversed and the bread turned on the paper. The Chinese make white wine of rice; and in the East, ardent spirits are made by fermentation and distillation. It may be made into beer by mixing 1 part by weight of malted barley with 4 parts of crushed rice, previously mixed with its own weight of water. Rice is often used and crushed with the husks on, when it is called *Paddy*, or more properly *Paddee*. It is thus largely exported to Europe to avoid duties, especially to England; and is thus called *cargo rice*.



OATS.—*Avena sativa*, C 3, O 2, Graminæ. sp. 9—34. Ds. A. 3 ft.—from *to covet*. This is a grain well known in our country. It is much grown and commonly used here as food for horses, and some little is eaten by the people. In England it was formerly much used as bread. It was accidently discovered there in a field of potatoes, in 1788, but its origin is not known. It is best adapted for northern and moist climates, and succeeds in almost any soil. The meal is very nutritious, but a little bitter. Beer was formerly made of it in England and Poland. Freed from the husks it is called *Groats*, and is used for broths, etc., for sick and infirm persons. It is cooling and laxative. Ground into *oatmeal*, it is made into cakes, puddings, etc. A nutritive jelly is also made of it, boiled in water, with sugar, etc.



A new variety called *skinless oats* has been introduced from Holland and China. It is more nutritive and better flavored, yields more and is more easily cultivated than the common oats, and but half the quantity of seed is required for the crop. For culinary uses it is very superior. The varieties are entirely from the continent of Europe, where it is the hardiest of all the grains. The branches bend, so that light and air visit it and the rain washes the grains, and the deposit of larvæ is thereby prevented. Heat and drought are unfavorable to it.

The species commonly cultivated, *Avena sativa* has many varieties, of which are the black, or long-bearded, the white, red, and naked oat. The best, however, is said to be the *potato oat*, so called from its being found growing with some potato plants. This requires soil well prepared, where it yields abundantly. The seed time of oats is in March and April. It is sown broad-cast, from 4 to 6 bushels to the acre, and the produce is from 20 to 60 bushels. The *Siberian oat* is cultivated far at the North.

The *nutritive properties of oats* are less than any cereal grain, being but 75 per cent. 14 lbs. yield 8 lbs. of flour. Malt was formerly made from oats and wheat; that of the latter produces a strong-bodied and high-flavored liquor, while that of oats produces a light, mild and pleasant beverage. A drink called *mum* was formerly made in part of oats; and the English gin or geneva is made of oats and barley, distilled with Juniper berries and oil of turpentine. 100 lbs. of oat meal are estimated to yield 36 gallons of spirits.

The wild oat is a very troublesome weed; the seed often remains a century under ground without injury, and thus is perpetuated. Hygrometers are made of the straw and its seeds are used as flies in fishing. No botanist has yet ascertained satisfactorily the native place

of this or any one of the cereal grains. It is calculated for northern climates, as in Italy and France the ears are small and husky. A warm climate is as uncongenial to it as a cold one is to rice. In Scotland and Ireland, where it is a principal food, it is said to be cultivated in the proportion of 10 bushels to one of any other grain. In 1765, 623.000 persons in England and Wales were estimated to be consumers of oats. Ireland exported in 1825, chiefly to England, 12.025.632 bushels, in grain and in meal 204.607 qrs., or 1.636.936 bushels. France produces about 90 millions of bushels, 25 millions of which are used for food, mostly in the southern provinces. Oats are largely shipped from Odessa, as the product of southern Russia. The crop of last year in the United States was 150.883.617 bushels, being an increase on the crop of 1840 of more than 50 millions of bushels; of this, New-York and Pensylvania raised over 24 millions each.

BARLEY.—*Hordeum*, C 3, O 2, Graminæ, sp. 9-12, Ds. A. ½—1 ft. This is considered in England next to wheat in importance, but it is less so here than Indian corn, rye, rice or oats. As a bread corn it is now less esteemed abroad than formerly, but it continues to be greatly used in the manufacture of beer and other spirits. Eastern traditions have it that this was the earliest grain used as food for man, and to this as well as to other grains they ascribed remarkable peculiarities. But, with the Eastern people, as with our Indians and other reputedly ignorant people, what was not understood was referred to some supernatural agency, nor was this more apparent then, perhaps, than at the present comparatively enlightened period of the world. The seed of barley rarely if ever germinates, if sown by chance; while some of the grasses classed with barley are never found to be useful as human food, or susceptible of material improvement by culture.

Barley is capable of a wider range of cultivation than wheat, sustaining as it does greater heat and maturing more readily in the brief summers of northern climates where wheat will not ripen. It is indeed the earliest sown and the earliest reaped of the summer grains. The season of maturing is often not longer than 6 or 7 weeks. Two crops of it are annually obtained from the same soil in Spain and Sicily. It thrives best on light dry soil, but it is nevertheless an expensive grain. It is reckoned next to wheat in Great Britain, on account of its malting qualities; and is there much used as food for the people, and also for fattening black cattle, poultry, etc. The barley consumers in England are estimated at 730.000. The usual crop is from 25 to 35 bushels of 50 lbs. per acre. The sale rate is 48 lbs. per bushel. The crop of the United States last year was but 3.871.622 bushels; and this, probably, chiefly for brewing and emigrants.

Excessive moisture is extremely injurious to it. If this is felt before the formation of the ear, the leaves become yellow and sickly and the ears may not appear; if afterwards, the grain sprouts and the ear

assumes the appearance of grass, if the wet is soon followed by warm dry weather. This rapidity of germination, though destructive in one case, is favorable for its conversion into malt, which is the process of germination. But we cannot believe that this latter circumstance is a redeeming consideration for its use in manufacturing it into ardent spirits in such immense quantities. Barley contains more starch, but much less gluten than wheat, 7 parts in the 100 being ready formed saccharine matter, which wheat does not possess before germination, The four varieties of barley are the result of differences of culture, soil, and climate, as with rye, etc.



Spring Barley, H. vulgare, or two rowed barley is the kind commonly cultivated, and this is of two sorts, the common and the *rath-ripe* barley, as it is called in England; but the latter is occasioned by long culture on warm gravelly soils. Seeds of this kind, sown on cold or strong soils, ripen two weeks earlier, the first year, than if taken from the latter kind of soil. The *Pilurian* barley has a broader blade and deeper green color than the common: it has shorter ears and with but from 5 to 9 grains, while the common kind has from 9 to 13. It arrives at maturity two weeks earlier than other kinds.



Winter, or *Square barley*, H. hexastichon, is the second species. It is more hardy than the first, and hence is more cultivated further north. The grains are large and full and its spike is thicker and but 2 inches in length and square. The number of grains is one-third more, often yielding 40 grains, which are disposed in six rows, two on each of two sides and one on each of the others.

Long eared, or *two rowed barley*, H. distichon, is considered a good sort and is considerably cultivated, though apt to lodge. The grains are in a double row, lying over each other like the scales of a fish. Its malting qualities are said to be excellent.

Sprat, or *battledoor barley*, H. zeocriton, has shorter and broader ears than either of the sorts mentioned; its beard is longer and the grains lie closer together than that of other kinds.

The rest of the species are weeds. French barley is barley freed from the husks, as is Pearl barley. It is a singular circumstance that the nativity of this and all the useful grains is unknown.

The budding of the oak is taken as the time for sowing barley, but the time differs in different countries. The average weight of the bushel of barley is about 50 lbs.

The Romans cultivated barley as a horse corn, and also for the army. Gladiators were called *Hordearii*, from their feeding on it. It was cultivated 1500 before Christ, and is often mentioned in scripture. *Pearl barley* is produced by grinding off the husks, when it is used in soups, gruels, and medical drinks. *Barley flour* is the ground grain, and is made

into puddings or pottage which, spread in thin cakes and toasted, is eaten warm with butter, cream and sugar. The malting property of the seed depends on the fact that the lobes or cotyledons of the seeds are always converted by the heat and moisture of the earth into sugar before the young plant is produced; and malting is an artificial process of effecting the same thing. The chemical constituents of mucilage and sugar are nearly alike.

The use of barley in preparing fermented liquors is very ancient. Its invention is ascribed to the Egyptians. In Nubia the green ears are boiled in water and eaten with milk. The beer of the Greeks was called *barley wine*. The ancient Germans also made wine of it. It was the general drink of the Anglo Saxons, wine being the drink of "elders and the *wise*," they did not, however, use hops in their ale, as these were first used in the Netherlands, in the beginning of the 14th century, and in England two centuries afterwards. There are more than 30 millions of bushels of barley annually converted into malt in Great Britain, and more than 8 millions of barrels, or 288 millions of gallons of beer made, of which four-fifths are strong beer.

One would think from this—and certainly not without reason—that, in addition to the vast quantities of wines and ardent spirits made, imported and drank in that country, that it must be a "land of drunkenness;" and when we find this statement accompanied by the following remarks from the professedly pure and philanthropic source from whence it is derived, the fact is not more startling than the conclusions are mortifying. "This is," says the commentator, "a consumption by the great body of the people of a *favorite* beverage, which indicates a *distribution of the national wealth, satisfactory by comparison with the general poverty of less advanced periods of civilization in our own country, and with that of less industrious nations in our own day.*"

We might enquire, perhaps, without being charged with presumption, if "the annual distribution" of 40 millions of bushels of barley, thus in our opinion infinitely worse than wasted, to hungry millions of poor, would not "indicate" a far more "*satisfactory* distribution of the *national wealth?*"

55,000 acres of land were occupied in 1838 in the cultivation of hops, and the malt on which duty was paid was 40,505,566 bushels; and in 1836, 44,387,719 bushels. Estimating the product at 30 bushels the acre, the land which this must occupy, is 147,959⅓ acres, to which add that occupied by hops, and the land employed for the purpose of producing malt liquor, would be 202,959⅓ acres of prime soil. Calculating the soil to produce the same number of bushels of wheat as of barley consumed, as above, and each bushel at 60 lbs., the product would be 2,663,263,140 lbs. Now, estimating 500 lbs. to support one person, or as equal to 480 lbs. of flour, the estimated annual consumption of each individual, and this land would support 5,326,526 persons! who

are, in fact, deprived of bread by this "*satisfactory* distribution of the national wealth!"—to say nothing of its wretched and destructive effects; or, to use more apt words, "the *poverty* of *less* advanced periods of *civilization!*"

The beer manufactured in Great Britain and Ireland, according to the returns of 1830, which are the last, was over 9,500,000 barrels! or 342,000,000 gallons (!) the proportion for Ireland being estimated at one million of barrels, or 36,000,000 of gallons. In view of such facts, another eminent British writer says, "Barley ranks, in importance, next to wheat, as affording an *innocent and invigorating fermented liquor.*"

Besides this there were imported into G. Britain, in 1840, 8,518,489 gallons of wine, 6,451,743 of which were retained for home consumption. There was also imported during the same year 8,011,017 galls. of ardent spirits. If these amounts be added to the foregoing, viz: 9,500,000 barrels, or 342,000,000 gallons of ale, beer and porter made and sold in Great Britain and Ireland, as per returns of 1830, the result is (deducting, say two million gallons of spirits for exportation,) 354,462,750 gallons! of these alcoholic liquors drank there annually! But this does not include the large quantities of gin, wine and rum, manufactured throughout the kingdom, or the many thousands of private breweries.

But whatever may be said of the use of malt liquors in such vast quantities, or whatever the motive may have been for remarks like those we have quoted, and others of a similar kind, it cannot be denied that in a country where, as we have shown, land is so scarce and valuable where millions of people are suffering for bread, an immense wrong is done by the continuance of such a state of things. Beer, ale and porter are, intoxicating drinks, the effects of which are scarcely less baneful than those of ardent spirits. Besides, it might be very difficult to discover where the "*invigorating*" qualities of beer are to be found, since it is known that beer does not contain a fourth part of the nutritive matter contained in the barley, itself not so nutritive a grain as others.

The melancholy picture presented by a late Parliamentary Report, from a "Committee on drunkenness," might have been so much more deeply toned by a consideration of the evils arising from the use of malt liquors, that we are not surprised that the inquiry was limited to ardent spirits, in the common acceptation of that term. It has, however, been well suggested by Dr. Bell of Philadelphia, that "they feared either to shock popular prejudices, or to exhibit a state of things which might lead to the diminution of his Majesty's excise." "If," continues that writer, "the inquiry had been extended in the manner suggested, (by the chairman of that committee) it would have brought to light, or rather put on a more formal record, a series of evils to indi-

viduals and the community, resulting from the general use of malt liquors, analogous to and in many cases rivaling those which follow in the train of ardent spirits."

It is indeed true, that "the beer-bibber suffers deeply, becomes heavy, stupid, sullen, and approaches in body and mind more nearly to the swine than does the gin and whiskey drinker, and who, if he feels flattered by the comparison, may be said to exhibit more resemblance to the tiger or mad dog." This, as well as the convictions of every man of common sense, as to the nature and effects of malt liquors, may be viewed in connection with the language of the interested, though reputedly eminent men we have previously quoted.

The amount of liquor distilled in the United States, in 1840, was 36,343,236 gallons, and the number of distilleries in the United States was 9,657. Pennsylvania distilled 8,784,138; Massachusetts 5,177,910; New York 4,008,616; Indiana 1,786,964, and other states less. The amount of Wines of all kinds imported in 1840 was $2,209,176; the amount of spirits from grain $420,069; do. from other materials $1,172,495; the amount of beer, ale and porter in casks and bottles was $135,485. The gallons of wine made here was 286,638; of which Ohio made 161,844. The total number of gallons cannot be seen from the price, but the amount of beer made is seen to be small from the small amount of barley raised in the U. States. But sufficient may be seen from the above facts, to stimulate the friends of temperance, both in the U. States and G. Britain, to increased and continued efforts.



BUCK-WHEAT, *Brank* or *Beech Wheat*, *Polygonum fagopyrum*.—C 8, O 3, sp. 36-60, Dh. A. 2 ft.—The last popular name of this plant is said to be a corruption of the first from *Beech and corn*. The fruit is a dark colored triangular grain, of increasing importance in this country. It was first brought from Asia to Europe, and was cultivated in England in 1600. It was first used as food for poultry, etc., but it is mostly used here, when ground, in making a fine light cake, much esteemed both by our countrymen and foreigners. *Buck-wheat cakes*, well prepared, are indeed a delicacy, and are, and long have been much eaten.

A late British writer, of acknowledged authority in many other matters relating to grains, says, however, "the seeds are rarely used as human food in *any* country and *never* so employed in England." Whatever the reason may be for this assertion, it is well known to be untrue as regards buck-wheat in this and several other countries. It is used, says Loudon, "in cooking and bread-making in various parts of Europe, to make cakes and crumpets *in England*, and as rice or gruel in Germany," etc. In China and the East it is cultivated as a bread-corn. The seeds are used in Germany for puddings, and in other

countries the meal is mixed with a small proportion of wheat flour and made into bread. In other places it is converted into malt for making beer and ardent spirits, especially in Dantzic.

This plant is an annual with handsome flowers and stem. The flowers are used for coloring brown, and are a great favorite with bees. Its culture has been recommended where bees are raised, principally for their use. The seed is sown in May or June, and its culture is attended with little labor or care. Although it readily matures, generally within 100 days, yet it is liable to be affected by early frosts, of which it is very susceptible.

The growth of Buckwheat is best on light, mellow and dry soils, where it yields from 40 to 60 bushels to the acre, on which from 1 to 3 bushels only have been sown. It makes excellent fodder in a green state. In a forward season, if sown in April, two crops may be obtained. It is generally cut for fodder when the blossoms are beginning to appear. Cows thrive well on it and yield an abundance of good milk for butter. It sustains heat better than other grains. It is sometimes ploughed in, when the flowers are full, manuring the ground for other crops; and in three or four months, it has become thoroughly decomposed. The *Tartarian Buckwheat* is of very luxuriant growth and is most highly recommended.

Fowls, horses, and swine are very fond of this grain and fatten well upon it, but for the two latter it should be crushed. It is said that swine, when first fed on the fresh plant, exhibit marked signs of intoxication. It yields a considerable quantity of good spirit and is used for this purpose by distillers in Europe. Bread is also made of it mixed with wheat flour. Some of the species are used medicinally, and many are incorrigible weeds in temperate climates. P. hydropiper is a powerful diuretic, and dyes woollen cloth of a yellow color. P. tinctorum is cultivated in China for dying a beautiful blue and green. B. bistota, *snake-weed*, is one of the strongest astringents, and may be used for tanning. The young shoots have been eaten in herb puddings and as greens. The roots of P. viviparum are likewise eaten and the flowers change into bulbs. P. aviculare has grateful seeds like the cultivated kind, and is the *knot-grass* of the English or hogweed. It is eaten greedily by most animals.

Leaves heart arrow-shaped; stem upright, without prickles; angles of seeds even; roots fibrous rather succulent; stem zig-zag, leafy, downy on one side; leaves entire acute, smooth; flowers handsome, numerous, red and white, in clusters. April to October. Remarkable for the number and variety of stamens in the species.

It will be seen that nearly two-thirds of the crop in the United States is raised in New-York, Pennsylvania, and New-Jersey. The increase during the past year in New-York was from 20 to 30 per cent., and in Pennsylvania it was in advance of former years. Little

of this grain is raised in the most Southern States. The whole produce of the country last year is estimated at 9.483.409 bushels. Great Britain imports annually about 80.000 bushels. France raises annually 25 millions of bushels, and the people use it to a considerable extent as food.



MILLET, *Panic Grass*, *Panicum milaceum*, or *Millium effusum*. C 3, O 2, Graminæ, sp. 582. Dh.A. & P. 1-3 ft. This is a species of *sorgham* and *sitaria*, which are true grasses. It is cultivated on light sandy soils. It is one of the chief articles of support among the people of parts of India, Arabia, and Syria. In Nubia it is grown to the exclusion of almost every other grain. The *panicum millet* is the smallest, yet the grains are the most numerous of all the grains; hence its name, *mille*, a thousand. There are two species of this with many varieties. The German millet, as with other varieties, resembles a jointed reed, 3 or 4 feet high. The principal use made of it is in feeding poultry. The *Italian millet*, a native of India and there called *congue*, is larger than the last and requires a warmer climate. Fowls and horses are fed with it. and the Italians and others make a dark and coarse bread of the flour. *Panicled millet* is the species commonly cultivated. The varieties of this are known by different names wherever it is cultivated. In the West Indies it is called *guinea corn*. In Egypt it is 5 or 6 feet high, while in some Eastern parts the stalk is from 16 to 20 feet long, and the leaves are 30 inches long. The seed was first cultivated in Switzerland about 100 years since. It is adapted to all kinds of soil, requires little manure and little labor, and does not exhaust the soil in comparison with its abundant crop.

The drill husbandry is believed to be best for its cultivation. It would prove valuable here in light dry soils and places. The yellow millet seed is by some sold here for puddings, and by some preferred to rice. It is a native of India, and is largely cultivated in China, and some in the West Indies. Millet is sown in May and June, and is ripe in four months. It is not subject to blight, nor is it easily injured by rain or drought. Weeding and hoeing during its early growth are all that are necessary. It will keep long and well when cut, if perfectly dry when stored. A species is raised in Borneo which is the chief support of man and beast. It is eaten parched, and even without any preparation. By some it is steeped in water, and by others, more particular, it is cleaned, pounded, and made into a light paste with fat. The juice is often sucked from the stem. The Nubians prepare a fermented liquor from it which they esteem as wholesome and nutritious. A good vinegar is also made of it by fermentation. The stalks, managed like sugar cane, yield a sweet juice, of which excellent sugar is made. There are three species—the Polish, German, and the Indian.

QUINOA is the name of a Mexican grain-plant, recently introduced and exciting attention in Europe. In Mexico it ranks with the best grains. The leaves are used as a spinnage or as greens, and the seeds in soups, broths, or like rice. The seeds ripened first in England in 1834: it is considered a great acquisition as a field plant; and as is thought, it may be cultivated like barley. It will thrive best in the United States and should be introduced.

Having finished the grains, the following is the sum total of exports. The amount of the grains, flour and meal exported from the United States in 1840 was $15.049.013, besides ship bread, $428.988. Of this was wheat $1.635.483; flour $10.143.615; maize $338.333; do. meal $705.183; rye meal $170.931; rye, oats, etc. $113.393; rice $1.942.076.

Proximate Principles of the grains, their uses, &c.

We have before alluded to many of the uses and qualities of the cereal grains under their respective names; but the importance of these in life would seem to demand further a few general and practical remarks. The nutritive principles of the grains, as well as of most vegetable substances, are seen to be few, however different their form or flavor. These principles are termed the *proximate principles*, in contra-distinction to the *ultimate principles*, the elements of which the proximate principles are composed. They are chiefly *gluten*, *fecula* or *starch*, *sugar*, *gum* or *mucilage*, *oil*, &c., in the quantities of which, the relative merits of vegetable food consist.

Starch constitutes the bulk and the chief nourishing principle of most of the grains and the most important roots, as the potato, cassava, &c., and of the kernels of the leguminous plants, as the pea, bean, &c. It is insipid, inodorous, of a white color, and insoluble in alcohol, ether or cold water. But hot water, between 160° and 212°, readily dissolves it, and converts it into a tenacious jelly. Treated with water and a small quantity of sulphuric acid, half its bulk may be converted into sugar. Thus the nutritive principles of the potato, not less than the arrow root, salep, &c., depend on the starch they contain. Starch is also found in the roots and other parts of many shrubs and trees; and these have been used for food in times of scarcity. Thus the inner bark of the pine and larch trees is ground with rye meal and made into bread in parts of Sweden and Norway. In some trees it is so abundant as to be as easily extracted by trituation with water, as from potatoes.

The process of obtaining starch, from its importance as food and in the arts, may not be without interest. It is obtained chiefly from wheat flour and the flour of potatoes, seeds, &c. This flour is slowly and repeatedly washed through a cloth or seive into a vessel of water, when the starch is precipitated in a fine white powder, and the gluten

remains in the form of a grey tenacious substance. Arum roots, acorns, horse chestnuts, &c., may be, and are used in Europe for making starch. These, with the potato, are grated into a hair seive and the starch washed through. Oily seeds require the oil to be pressed out before the farina is extracted. Water, a little acidulated, is mixed with the flour to regulate the fermentation and prevent the mixture from becoming putrid. It is then left ten days in summer and fifteen days in winter, when the water is skimmed, poured off, and the starch washed from the bran and dried in the air or in an oven.

Potato starch, when roasted at a low heat in an oven, forms a gum much used by calico printers. Starch is otherwise in great use for domestic purposes, in manufactures, and occasionally as a medicine. Potato starch differs from that of wheat; it is more friable, the grains are larger and it decomposes less readily by fermentation. It is sold under the name of *English arrow root* and *potato sago*, in parts of France, and nearly resembles the starch of these plants, which are composed mostly of starch. A sympathetic ink is made by writing with starch-water on paper, and then, at any time afterwards, washing it with Iodine in alcohol, when the writing appears of a deep blue color. When triturated with iodine, various and fine colors are produced; hence each is a test for the other.

The ultimate elements of starch are carbon 43.48, oxygen 49.45, and hydrogen 7. These differ little from those of sugar, but starch is much better calculated for human food, as it does not undergo the changes in the stomach which sugar does, producing, frequently, flatulency, &c.

To change starch into sugar, 2.000 parts are diffused in 8.000 of water containing 40 parts of sulphuric acid. The mixture is boiled 36 hours in silver or leaden vessels, and stirred during the first hour, and occasionally afterwards; and the water is replaced as it evaporates. Chalk and animal charcoal are then added, and the whole is clarified with the white of eggs, or other substances, then filtered through a flock of wool, and the liquid concentrated by heat till of a syrupy consistence. The basin is then removed, and its sulphate of lime precipitated by cooling; the syrup is decanted and evaporated to dryness. Sugar and gum are also obtained by mixing starch with dried gluten. 1 part with 12 of water, fermented by dry gluten, yields 47 sugar, 22 gum, etc., in 100 parts. Starch is thought to be sugar partly organized.

Gluten and Vegetable Albumen are commonly combined and are the most important of vegetable proximate nutritive principles. Wheat flour owes to its gluten the property of forming light and spongy bread, the mass being distended or raised by carbonic acid disengaged by its fermentation. This substance abounds in wheat flour and gives to it its advantages in making bread. Vegetable albumen resembles that

of animals, and is contained in most of the grains, peas, beans, seeds, almonds, and most nutritive fruits. Gluten also resembles the fibrin of animals, the substance of muscular flesh and its nutrive part. The gum of vegetables dissolves when placed in water, forming a viscid solution, while the *mucilage* is not soluble, but forms, with water, a thick paste. *Oil* is a principle abounding in some vegetables, especially in some fruits: as the nuts, etc., and it resembles some animal oils, as butter, etc.

Of vegetable *Sugar*, one of the most important of the proximate nutritive principles, we shall speak more at large in a distinct article.

The proportions of proximate principles in 100 parts of the chief of the cereal grains are estimated as follows:—

	Gluten.	Starch.	Sugar.	Gum.	Albumen.
Wheat	7 to 14½	56 to 72	4 to 8½	2 to 6	
Rye	5 to 9	60	3½	11	3
Barley	3½	67	5	4½	1
Oats		59	8½	2½	4
Rice	84				

Indian Corn is principally starch with some sugar.

Water is in the proportion of 8 to 10 per cent. and bran from 1. 20 to 1. 30 per cent.

Peas and beans consist mostly of starch, with some oil and sugar. Potatoes possess a dry substance in the proportion of 24 to 30 per cent. and water forms the remainder. This dry matter is composed of from 13 to 15 per cent. of starch; 2 to 9 of fibrous matter; 1 to 2 of vegetable albumen, with 70 to 80 of water. Like some other roots, therefore, potatoes depend on starch for their nutritive properties.

Vegetable diet should embrace a variety of proximate principles in order to afford health and strength. Wheat supplies a considerable variety of these in its starch, gluten, sugar and gum; but Rice does not afford this variety and therefore some other substance should be eaten with it; vegetable oil, or animal fat, is commonly used. Three of these proximate principles are found in milk, which is therefore highly nutritive. One of these, in the form of butter or cheese, is consumed to a great extent. Ripe fruits afford an abundance of sugar and mucilage, and hence are a valuable addition to vegetable diet. In the date, much eaten in countries where the chief aliment is vegetable, abounds in these principles, as with many of our own fine fruits. These, with rice or millet, therefore, afford a good diet.

It will be apparent, from what was said of the requirements of the body in the latter part of the chapter on the chemistry of agriculture, that this variety of proximate principles is absolutely necessary, and that those restricting themselves to vegetable diet necessarily require more and a greater variety of food to meet the demands of the body. The practice therefore, whether from choice or the advice of others, of

limiting the diet to one vegetable substance, or even two of similar kinds, cannot reclaim or sustain the health of the body. Besides this, the peculiar constitution of some may not render certain substances either agreeable or nutritive, as is often the case with oily, starchy, and saccharine matters. But much depends on the habits of individuals.

The mode of preparing vegetable food will appear important after what has been said of its chief principles. *Bread* is first among the forms in which vegetable principles are combined. That made of wheat-flour is most common in this and perhaps most European countries.

Bread.

This is applied, figuratively, to the food of man, and literally to food prepared from wheat, rye, oats, barley, rice, maize, peas, beans, etc. It is still unleavened in the East, after a lapse of 4,000 years, since its use there was recorded. The improvements which have been made in it in Europe are of comparatively recent date. In thinly settled countries, and in the early history of all, the making of bread, is the business of the household, but by the growth of cities it has become a trade. Such was the case with the Jews, as the bible speaks of "Baker's street."

Bakers were unknown in Rome 850 years after its foundation. In England the tenants of a manor under feudal laws were obliged to grind at their lord's mill and to bake at his oven, and subsequently at the "corporation ovens." The bread of the Jews was mostly made of wheat, barley or lintels and beans. Corn was ground in the East then as now by females, in a hand-mill, and in quantity sufficient only for the day. It was regarded as the symbol of all food; hence the expression, "give us this day our daily bread." Wheaten bread, in the 16th century, was a luxury and reserved for the rich, while the poor fed on coarse kinds.

Unleavened bread is a simple mixture of meal and water, made into a tough cake. The component parts of the flour are little altered. Thus oat meal cakes of the north of England and of Europe are unleavened. The soldiers of Scotland used to carry a griddle or girdle to bake their cakes on, and this is now a common appendage of every northern cottage. A plate of iron is also used in the East, though commonly the bread is baked in a pit in the centre of the floor. Leavened bread is of two kinds, that fermented of sour dough, or leaven, and that fermented with barm or yeast. The bread of leaven alone is sour, hence a small piece of sour leaven is kneaded with fresh dough, which soon ferments the whole mass, and hence the scriptural phrase "a little leaven," etc. The use of barm and yeast was a great improvement. It is the foam collected on the surface of beer in fermentation, and it was brought into use in baking bread, by the Parisians;

but the physicians there denounced its use in 1688, and it was introduced with difficulty elsewhere. It was made into balls and largely exported. At length, having been analyzed, it was found that its properties depended on gluten and a vegetable acid. It is now made with hops and malt.

The heat in baking bread is 418°, and the bread in the process looses one fifth of its weight in water. The peculiar odor of new bread, which is probably alcohol, is lost by keeping. The gluten of flour in baking unites with the starch, thus giving to it its nutritive properties.

The best bread is made of wheat flour, owing to its having more gluten than that of other grains, this being one-fifth of the whole. Oats make a pleasanter bread than barley or rye, but is apt to cause heartburn; that of barley is heavy, viscid and flatulent; and that of rye, acescent and purgative. Bread is sometimes made of turnips. Of potatoes and rice we have before spoken. That made of peas generates a gas in the intestines, and that of chestnuts—perhaps the acorns used by the ancients for bread—is heavy and indigestible. Sago is much used for bread in the Moluscas. Nearly a pound of salt is added to a bushel of flour by the bakers; but the French use much less.

The process, where potatoes are used, is to beat up the potatoes in a tub; add water, yeast, and a handful of flour, and stir well; set aside for 8 hours for the first fermentation; then add water and flour and stir the whole briskly; then set a proper heat to rise (according to weather.) The sponge stands six hours, during which it rises and falls twice; more water, flour and salt are added, and the sponge is broken up by hand into a thin consistence, and a little flour added to work well. It is then left in the trough two hours; taken out, divided into loaves, and baked for two hours.

Acorn bread will be found under the head of oaks and acorns.

The starch of bread is most favorable for its form, as well as nutriment; its sugar for its fermentation, and its gluten for its lightness, as well as nutrition. The flour should be pure, should be kneaded with light water, seasoned with salt, fermented with good yeast, well baked at a proper heat, and appearing when baked, through a magnifying glass, like honey comb.

Of flour and water is made a paste which undergoes fermentation, if exposed to heat, and which is often used as *leaven*; but this is more liable to make sour bread than yeast. The paste is simply a viscid tissue of gluten, the interstices being filled with starch, sugar and albumen. The leaven acts on the sugar of the flour, giving rise successively to the vinous and acetous fermentations, to alcohol, and to acetic and carbonic acids. The gluten of the dough resists the disposition of the latter acid to fly off; and the porous and spongy character of the bread is the result—forming cavities by its expansion.

The want of gluten in some grains and roots prevents the rising of the bread made of them. All the alcohol produced by the vinous fermentation of dough is evolved in the process and in baking. The carbonic acid not being volatile, is likely to prove injurious to bread, especially if the flour should not be fresh or of a good quality. To correct this, sub carbonate of ammonia, or carbonate of magnesia, may be added, which both prevents the acidity and improves the quality of bread. Thus, Sir H. Davy says, loaves are made by it to rise well in the oven, and when baked are light and spongy, have a good taste, and keep well. The carbonate of ammonia is entirely dissipated in baking; it neutralizes any acid in the dough and makes biscuit short.

20 to 30 grains of carbonate of magnesia to the pound of new and poor flour much improves bread; and when the flour is of the worst quality, 40 grains are required to produce a like effect. Alum is also much used by bakers, in the proportion of 2 oz. to 5 bushels of flour. A distinguished chemist says that it is impossible to produce white, light and porous bread in London without the use of alum, unless the flour is of a very fine quality. It is believed that no such declaration is necessary in this country, yet we have reason to believe that much poor flour is used by our bakers, and that alum is much resorted to to improve the appearance of their bread. A simple method of detecting this is to mix crumbs of the stale bread in water, squeeze the paste through a cloth, then pass the liquor through a filter-paper and the resulting limpid infusion, if it contain alum, will exhibit a white cloud on adding to it a dilute solution of muriate of barytes. These salts are said to have little effect on the rising of bread, and the former is converted into an acetate by combining with the free acid in the dough. The use of common salt is thought to be slightly like that of alum or blue vitriol.

The effect of such bread is evidently injurious, especially on those who are costive, with impaired digestion. Both white and blue vitriol are also used by bakers; much more in parts of Europe, we trust however, than in this country, for there can be no reasonable apology for the use of any deleterious substances in the bread of our people; nothing but reckless cupidity can induce the practice. In Belgium and France this is most common. The ostensible effect of the latter on bread is like yeast, to retain the gas and render the bread more porous. A minute quantity produces this effect, even a grain in 7½ lbs. of bread. Double this is said to produce a greater rising, but still more renders the bread flat and moist.

Bread is sometimes adulterated with carbonates of soda and potassa, to prevent it from becoming soon dry. Plaster of Paris, chalk, whiting and burnt bones are also used.

Potato flour is a common addition to wheat flour in bread making in Europe, but this can hardly be called an adulteration, if the price is

made to correspond. An admixture of a fourth is not unsatisfactory. Equal parts render the bread close, hard and of difficult digestion. Fresh potato starch has been added to flour with much success in France, and danger of famine has been thereby prevented. Millers have added 20 per cent. and the process of admixture has been so improved by the addition of sugar or barm that 50 per cent. has been added. By the liquefaction of starch and the addition of malted barley still higher proportions have been made. A bread of fine appearance composed entirely of starch has been still later made, but the entire absence of gluten, and of course of nitrogen, so essential to the animal body, must preclude its use. By other experiments a principle called *caseum* has been found to be an immediate constituent of gluten, which being rendered soluble by the addition of bicarbonate of soda, has been added to starch in the proportion of 20 to 100 of the starch, and being dried two days in the sun and ground, makes good bread with yeast, etc. If potato starch and wheat flour be mixed and ground together, a very large proportion of starch may be used, even to 50 or 75 per cent. This may also be used in like proportions mixed with wheat and rye.

There are so many processes for making good bread, cakes, puddings, and other preparations of flour, that it will not be important to our purpose to describe any one of them. Bread made of unbolted flour, or more familiarly, *bran bread*, is now much used; it is recommended to dispeptics and to obviate costiveness, etc.; with those in health, having much exercise and sensible digestive organs, it is irritative and wanting in requisite nourishment. Fine bolted flour is also very apt to form a concrete mass in the stomach, and in this state is less readily and effectually digested than coarser flour. Very much of the flavor and goodness of bread, under all circumstances, depends on the manner in which it is made. Machinery has been introduced to knead dough more effectually; and the addition to the flour of the salts before mentioned prevents the souring of the leaven and dough in summer.

Warm bread is at all times unwholesome, but especially in warm weather, to those who do not exercise much in open air and to the dispeptic, occasioning a train of unpleasant consequences. The bad effects of this are increased by the addition of melted butter. Fresh bakers bread, particularly when warm, is indeed one of the principal evils of city diet, and one giving rise to numerous diseases; yet some persist in its use, despite the suggestions of their own good sense. The flavor which is the reputed advantage of fresh over stale bread, is not, in our opinion, equal to that of thoroughly dry bread. Bread, therefore, as a safe and general rule should not be eaten in any way until it is a day old.

Rice.—There are a variety of forms and admixtures in which flour

is made into light nourishing aliment, alike valuable to the diseased and healthy, and among the useful additions to it is rice. This boiled and mixed in the proportion of 1 to 3 of flour, and made into dough with the water in which it has been boiled, affords 1 lb. and 14 oz. of fine bread. The flour of beans added to wheat flour also makes a nutritious bread. Five pounds of this with 50 of the flour of wheat, kneaded with salt and yeast produce 93 lbs. of dough, or 82¼ lbs. of bread; the wheat flour alone yields but 69½ lbs. of bread. 280 lbs. of flour are estimated to make 347½ lbs. of bread; but flour varies in the weight of water it absorbs. In London it is said the amount of bread calculated upon for each person of a family is 6 lbs. per week or 13½ oz. per day.

Ginger-bread is an important bread, from the extent of its use, for the composition of which the following receipt is given by a distinguished English writer—1 lb. of flour; ½ lb. of molasses; ¼ lb. of raw sugar; 2 oz. of butter; ½ oz. of carbonate of magnesia; ½ oz. of tartaric acid; ½ oz. of ginger; ½ oz. of cinnamon and 1 oz. of nutmegs, or these in corresponding proportions. In this way the bread is ready for the oven in an hour.

Rye flour is one of the most common mixtures with that of wheat. The grains are grown and ground together for this purpose in many places. Thus-grown they are called *meteil* in France. The bread is very wholesome and well flavored, having less solidity in the stomach than wheat bread. The proportion of the flours, when mixed, is one-third or little more of rye flour. Rye bread retains its humidity and at the same time its flavor. When ground coarse, the bread is good for the dispeptic and costive. Boiled in water (*rye-mush*) it is recommended by the faculty, with milk or molasses, in the morning, for constirpation, and also in some surgical cases.

Barley, from its small quantity of gluten, does not make good bread. The husk is acrid and laxative; but deprived of this, in which state it is *pearl barley*, it is quite nutritious and is much used. 2½ oz. of pearl barley to 4½ pints of water forms the well known *barley water* which, with lemon juice, is a very refreshing drink in fevers and is otherwise very nourishing. Rice water is used in a similar way. The first is made as follows: wash the seeds, then boil a short time in half-pint of water, throw away the water, pour on four pints of hot water, boil down to two pints, and strain. This may be made of barley flour; two spoonfuls being boiled for ten minutes in one quart of water, strained, sweetened and flavored.

Oat meal, though not easily made into bread, forms fine cakes with milk and aromatic seeds, baked before the fire. Boiled with water till rather thick, it is nutritious and useful in sickness; but the meal fermented in water, boiled and strained, forms a jelly still better. The bread is bitter; the meal is chiefly used in gruels, which is good, drank

after purgative medicines and in cases of a morbid condition of the bowels. Two parts of oat meal and six of water are mixed; a quart of boiling water is added, then boiled and stirred ten minutes, sweetened and flavored. Or a pint of boiling milk is added to a pint of water, with which the meal has been mixed; boil and stir five minutes, strain and sweeten. This is excellent for invalids. Wheat bran thus prepared is also good for such persons, for catarrh and to preserve laxity of the bowels.

Rice having no gluten is unfit for bread. It suffers no change by transportation, like most grains, and is most easily prepared for food. It is excellent for long sea voyages. The Chinese prepare it numerous ways and with much delicacy. It is commonly boiled and served with lintels or beans. Boiled and pressed into small cakes it is preserved a long time ready for use. A favorite porridge is made of it. It nourishes with little irritation and little residuum. In violent diseases and lingering complaints, rice diet is excellent. Inflammations of the bowels, dysentery, chronic complaints of the digestive organs, looseness of the bowels, with gripings, &c., are controled by rice diet and rice drinks. It is seasoned with sugar, cinnamon and salt. Rice jelly is made of two oz. of the flour, quarter lb. of loaf sugar and a pint of water, boiled till thick, flavored and cooled. Ground rice is apt to become musty by keeping; the *grain* answers all purposes. In convalescence, or in forming states of disease, it is equally valuable. In the summer complaints of children, for medicine and nutriment, nothing, it is said, is better than rice water or rice and cream, sweetened and salted. Salt is best to add for acidity of the stomach and flatulency of the bowels, either to this or barley gruel. Rice and milk is an excellent nourishing diet, when there is not a state of inflammation. The rice is simmered three or four hours with the milk. This, if then baked brown, forms a very fine wholesome pudding, if desired.

Indian corn meal, like other *meal* not susceptible of panification is not made into bread alone, but it makes with flour an excellent bread, retaining its softness for 36 hours. In this country, it is thus much used, and also in cakes and puddings. Mush is made by stirring a portion into boiling water; it is then eaten with milk, cream or molasses. We have spoken of many preparations of this important grain. A gruel is made of it like oat and barley gruel, and for like purposes. A peculiar and slightly acrid oil is contained in the bran, so that this should be entirely removed. This, however, is probably the stimulant of the grain, when fed to animals.

Buckwheat is not used in the usual form of bread, or is not susceptible of panification. Indian meal mixed with buckwheat flour when used for cakes is a great improvement. It is mixed with the flour of other grains in Europe and made into bread. It has little or no gluten; its starch being its chief nutriment.

Wood bread.—A palatable and nutritious bread is made of the beach and the wood of other trees, destitute of turpentine, in the following manner—All the soluble parts are washed from the wood, reduced to fine powder by frequent maceration and boiling. It is then repeatedly heated in an oven and ground like the grains. It then has the smell and taste of corn flour, though not quite so white; but, like that, it will not ferment without leaven, which is best made of grain flour. The bread thus made and well baked is spongy and uniform. A thick, trembling and nutritious jelly is also made by boiling the wood flour in water and seasoning it as usual.

The composition of vegetable secretions may be stated as follows.

Substances.	Carbon.	Water	Oxygen in excess.	Substances.	Carbon.	Water.	Hydrogen in excess.
Gum, - -	57.318	42.682		Acid, Gallic,	56.64	43.36	
Starch, - -	43.481	56.519		" Acetic	46.23	55.17	
Tannin, -	51.160	41.477	3.568	Oil, Olive, -	77.21	10.71	12.08
Cane Sugar	44.2	55.79		" Almond	74.40	13.37	4.45
Grape Sugar	36.71	60.08	3.48	" Anise, -	83.468	14.887	6.465
Lignine, -	50.	50.		" Lavender	75.50	14.59	9.55
Acid, Citric,	41.309	34.234	24.397	" Roses,	82.053	4.442	12.631
" Malic	40.68	45.76	13.56	" Turpen.	88.348		11.652
" Oxalic	19.04	42.85	38.11	Hydrocynic Acid,	44.39		3.90
"Tartaric	36.	36.	32.				
" Ulmic,	56.7	43.3				(nitrogen	51.71)

FOOD OF THE ANCIENTS.

In the early condition of society, population was scattered and sparce, from the nature of the food on which man subsisted and the difficulty of obtaining it. The increase must have been slow in comparison with the present period, and especially in view of the increased casualties and consequently comparative increase of deaths, as the result of the arts both of war and of civil life.

In the tropical climate people have required, or desired, little animal food; and with those in what has been termed savage life, animal food has been procured from wild beasts by the chase. This, it has been suggested, may have arisen with man from seeing one superior animal pursue, destroy and devour another. But it is in a more civilized state that man has devoted his attention to the cultivation of vegetable food; and his advancement in this has ever kept pace with his advancement in civilization. Animals, as a consequence, were domesticated, and especially those which are gregarious and the flesh of which is the most palatable and nutritious, such as neat cattle, swine, sheep, &c., and so also with fowls. Husbandry, therefore, ne-

cessarily succeeded the savage and pastoral life; and the cereal grains, leguminous plants, tubers, bulbs and various fruits were cultivated, and in such quantities as to be stored up for winter's use.

These improvements in the social condition of man have been introduced by conquests, but more especially as the result of commercial intercourse. There are, however, still those in the East, removed from such intercourse, who yet follow a pastoral life, but comparatively few who hunt wild game. The regimen among the most ancient people of the East, from the days of the patriarchs, has been little changed. It is now, as then, almost exclusively vegetable. Rice was cultivated among the early Egyptians and has continued the chief food to the present time. To this is added a variety of agreeable and nutritive fruits.

There have been those, however, who were far advanced in agriculture without intercourse with other people, as with the ancient Mexicans, the Chinese, &c. It is a remarkable fact in this connection that where vegetable substances are mostly cultivated and eaten, there population is most redundant, as in India, China, and the most populous parts of the south of Europe. As the arts of agriculture advanced in particular parts, population has increased; and, as we have before said, such have become most populous and happy. All history shows the truth of this and the evils resulting from an opposite state of things.

Among the improvements introduced in the progress of agriculture, was that of the aid of animal power. This, it has been said, is equal to five times that of man in France, and twelves times that of man in England and the United States.

For 30° on either side of the equator, vegetable substances may be said every where to be the chief, and in many parts the exclusive food. Beyond this, particularly towards the north, the proportion of animal food increases to near the arctic regions. But the great body of mankind have heretofore subsisted and now subsist on vegetable aliment. The most renowned people of antiquity, as the Egyptians, Greeks, etc. have subsisted almost entirely on vegetables.

The chief food of the heroic age, it is said, was barley, and barley meal-porridge, with oil. Wheat bread, olives and figs, with cheese and eggs, were the principal food of the Athenians in their best days. Onions, garlics and honey, were also much eaten; and animal food, fresh and salted fish, poultry and game, were eaten by the higher, yet little by the lower classes. The food of the Spartans was chiefly meal, eggs, cheese and occasionally meat. Wine was occasionally drank as with the Greeks generally.

The first animal eaten was swine, because otherwise the least useful, probably, while it was deemed wrong and unlawful to destroy the ox, one of the most useful animals, particularly in cultivating the soil.

The food of the Romans in their early history, as with the Spartans, was extremely simple and mostly vegetable, such as barley and pulse. Wheat was afterwards much cultivated, and barley was given to soldiers by way of punishment. The distribution of the public grain was cause of frequent excitement and disturbance, as are the corn laws of England at this time. Fruits were much eaten by the Romans. Flesh and poultry, as now, constituted much of their animal food. Pork was in high repute, as also the flesh of bears, dogs, asses, camels, and wild boars. Sucking puppies, water rats, snails and maggots were great delicacies, with grass-hoppers, locusts and other insects.

After the Romans, great changes ensued in the diet of the people who succeeded them, and in the arts of agriculture. Barbarism and poverty prevailed for five centuries, during which the soil was little cultivated. The Monks afterwards continued to cultivate small portions of soil, and are said to have been instrumental in continuing and introducing agriculture at later periods.

FOOD OF THE PEOPLE OF MODERN NATIONS.

There are in France, according to M. Dupin, 7½ millions who eat little or no bread, and 20 of the 33 millions are deprived of animal food. These last live on the grains and potatoes, while the above 7½ millions subsist on rye, flummery made of buck wheat, chestnuts, pulse and some potatoes. Improvements, however, are making in France, in food, as well as in the use of ardent spirits. The whole amount of vegetable food in France, as estimated for 1830, was 170 million bushels of wheat, 322 do. of other grains, and 130 million do. of potatoes and chestnuts—total, 622.500.000 bushels. This is about 19 bushels for each person. There were in 1826 but 6.684.952 horned cattle and 4.000.000 swine, in France, while in the United States there are of all of the above grains not less than 961.039.051 bushels; and with peas, beans, chestnuts, etc., not less probably than 1200 millions of bushels, or double the quantity raised in France, though with but about half her population. This would allow for each individual in our country 70 bushels. We have also about 17 millions of neat or horned cattle, 30 millions of swine, and 25 millions of sheep, with fish, poultry and wild game almost without limit.

In Switzerland the people are provided with about six bushels of wheat each; and in the city of Geneva with 6 oz. of animal food daily, or double that of the Parisians. The bulk of the people live on oat meal, potatoes, milk, coffee, with meat and half a pint of cider on Sundays; but a proportion have a little wine and meat two or three times a week.

In Italy the chief subsistance is on maize with rice, and in some parts potatoes, in others wheat, and in the Appenine regions, chestnuts.

Maccaroni, made of flour into small cylindrical rolls, is also much eaten by a large class.

In Spain the people live chiefly on the grains, though there is not a sufficiency raised for the wants of the people. Salted meat and fish are likewise much eaten. The people of Portugal subsist mostly on vegetable soups, salt fish and maize bread. The mass of the people indeed, on the Continent, subsist principally on vegetable food, consisting chiefly of the inferior cereal grains, pulse, the dairy, and small portions of meat or fish and wine.

In England the flesh eaten is said to be in the proportion of 107 lbs. to each person annually, but the great mass of the operatives are deprived of meat and of a sufficiency of vegetable food of any kinds. In the chief manufacturing towns they do not taste meat oftener than once a week, and are unable to obtain a supply even of the simplest nutritive vegetable food. They subsist chiefly on potatoes, the coarsest bread, oat meal and water. These, it is said, and "their equivalent in London think to find temporary relief from the knawings of hunger and the lassitude consequent upon excessive toil and close shops, in potations of the worst of intoxicating drinks"

In Scotland the food is of the simplest kind, chiefly oat meal, fish and products of the dairy. 280,000 acres of the land are said to be devoted to raising barley, principally for distillation, (which is much more than we have estimated heretofore,) and only 140,000 acres for wheat; so that the soil there wasted, it may be said, in raising barley for intoxicating drinks would raise annually 8,400,000 bushels of wheat, or 504 million lbs. of flour, equal to the consumption of 1,800,000 persons. Of 1,800,000 acres cultivated 1,260,000 are applied to the raising of oats. 300,000 barrels of herrings are caught on the coast, 100,000 of which are retained for consumption, and of 65,000 cwt. of dried cod 40,000 cwt. are retained. The quantity of intoxicating liquor made there in 1833 was about six million gallons.

In Ireland the chief food, it is well known, is potatoes, while in most other countries they are auxiliary food. Oats constitute the next in quantity of vegetable diet, and fish is the chief of the animal food; but in part as a substitute for meat, at particular seasons, on account of superstitious opinions. Of 181,654 barrels of herrings exported from G. Britain in 1830, 89,680 were consumed in Ireland. Fish are also abundant in the streams and estuaries. The swine and much of the grains are exported. The shipments to G. Britain of wheat in 1830, were 4,508,944 bushels; of oats and oat meal, 12,508,744 bushels; and in 1832, 69,624 cows; 150,000 pigs; 74,260 sheep, and 24,000 lambs. The whole amount of aliment in value annually shipped from thence to Great Britain is estimated at $44,400,000.

In the United States, as we have elsewhere said, the amount of vegetable and all other alimentary products are more abundant than in

any country on the earth. The slaves of the southern states are more abundantly furnished with food than the mass of the population in Europe, and even "luxuriously," says Dr. Bell, "compared with a large proportion of the operatives of Great Britain." They have a full supply of animal food, usually bacon or salt pork and fish with corn bread, to which is added rice and the common and sweet potato. In Virginia and the west, fresh meat is frequently given them. Generally each is allowed a piece of ground for a garden, where they raise vegetables and fruits for themselves and often for their masters, who pay them a fair price for these products. They have also poultry and eggs which they generally sell either to their master's family or at neighboring villages, and with the proceeds purchase groceries or some articles of luxury, either of food or dress. The house slaves are generally furnished with the food of their master's family.

It will have been seen from the products of the grains, potatoes, &c. that the people of our country are in fact over-fed, nor is vegetable aliment more superabundant than animal food. The mechanic and the laborer in this country eat meat more frequently and of a better quality than do large land proprietors in the south of Europe. Pork and beef are the chief animal food throughout the country; and this is variously prepared. Poultry and the products of the dairy constitute also a prominent part of the food of the people. The estimated value of Poultry in the United States, in 1840, was $9,344,410.

In Ohio, Kentucky, and Tennesse alone, were raised in 1840, six millions of swine; in New York two, and in Pennsylvania 1¾ million, and in the States collectively, 26,301,293. It may be estimated, Mr. Elsworth thinks, that the increase since, cannot be less than 5 per cent. and that therefore the present number exceeds 30 millions. If these average 300 lbs. each, the amount of pork, lard, bacon, etc., is annually 9.000 million lbs. The hams, at, say 20 lbs. each, give, with loss of one-third in curing, 800 million lbs. of bacon, and the lard, at 60 per cent., if the balance be tried up, would be 4.680 million lbs. This would give, at 8 lbs. of lard for a gallon, 585 million gallons of oil. But if half the swine be thus taken, the oil would be 292 million gals. or 25 times as much as all the sperm and whale oil annually brought into the country. The value of the oil and stearin, at 50 cents per gal. and the hams at 6 cents per lb., would be $170.250.000, or about double the value of all our exports. An increase of 1 cent per lb. would add 30 million dollars to the value. Swine are raised at the West at comparatively little expense.

The neat cattle in the United States numbered in 1840, 14.971.586, and now, by an increase of 5 per cent. per annum, 17.217.323; while in Germany, with 30 millions, and in France with 33 millions of people, there are not half this number and only one-eight of the number of swine. The sheep in the United States are estimated at 25 millions.

These, when the prairie lands are devoted to their growth, will increase astonishingly. The number of neat cattle in Great Britain has been estimated at 5.100.000, one-fourth of which, or 1.275.000 are annually slaughtered. The same proportion slaughtered in the United States would be 4.304.330 head, affording here about 4 lbs. for 1 consumed in England, with any differences, probably, of weight, etc. The difference too in swine, poultry, fish, and wild game, gives to the people of the United States an advantage in animal food of probably not less than six fold. The great difference also, as we have seen, in the amount of the cereal grains, potatoes, &c., presents this disparity between the two countries in a still stronger light.

The value of products of the dairy in the United States were estimated, by returns of 1840, at $33,787,008; (of which New-York produced about 10 millions); those of the orchard at $7,256,904; market garden products $2,601,196; all of these, however, are considered greatly below the true amounts. It is estimated that an American consumes three times as much animal food as an European, with a greater proportion of vegetable food, fruits, pastry, &c., or five times as much as an East Indian.

In Mexico the chief food of the laboring people is Indian corn, made into bread, porridge, or cakes. Cassava, beans, and the natural fruits of the country, constitute also a large proportion of aliment, with *chile* used in large quantities as seasoning for pulse, &c. Wheat forms a part of the food of the inhabitants of cities, where meat is also considerably eaten. The banana is said to be to the people of the torrid zone what the cereal grains are to Europe, and even what rice is to India. It has been estimated that the same extent of ground appropriated to the banana in Mexico, and which will support fifty persons, will not support under wheat in Europe, two persons.

Cattle in other parts of South America are very abundant, both wild and domestic; and nothing but indolence can deprive the people of abundant animal food. Some of the land proprietors have from 10 to 15,000 head. Half as many cattle are slaughtered in Caraccas as in Paris, with twenty times the population. The cereal grains are greatly imported in flour from the U. States. In Peru, maize is much eaten in various ways, also potatoes, fish, eggs, cheese and onions. 150,000 gallons of wine are made from the fine grapes of this country. In Brazil good wheat is raised, potatoes and fine fruits. The cultivated land is extensive and rich. Still, the grains are not adequate to the wants of the people. Cassava and kidney beans are the chief support of the Indians. Cattle are very abundant in some parts, but here, as in some other parts of South America, they are prized mostly for their hides. Meat is much eaten in the provinces about Buenos Ayres by all classes. Flour to a great extent is exported from this country to that city. The beef is of superior flavor; and great quantities are dried in the sun

and exported. The Paraguay tea, made from a shrub of the holly family, is greatly used. But we shall notice the vegetables and the various drinks made from them, under their respective heads.

The Persians make rice a chief aliment, united with wheaten cakes, sour milk and cheese, dates, grapes, melons, peaches, cherries, currants, and many other choice fruits. Wine is used freely. The products of the dairy are also abundant, derived as they are from immense flocks of wandering cattle. Most of our best culinary vegetables are there abundant. Little meat is eaten beside that of the flocks.

The Arabs every where have similar alimentary regimen. This is derived chiefly from their flocks of cattle and from a small quantity of grain, the flour of which affords an unleavened bread. Camel's milk and dates are also a common food; and in Egypt and Persia they have rice, and in other parts millet, with some wheat and pulse. Camel's meat is occasionally eaten, and sheep and lambs, with coffee and butter. The latter, indeed, is taken to excess, whole cups full in a melted state being frequently drank before breakfast. Water, camel's milk, and occasionally a drink distilled from rice, and coffee, are the only drinks.

The Abyssinians have, however, so great a relish for meat, though within a warm climate, as to cut the raw flesh from the live animal and devour it while yet quivering. The wound of the animal is afterwards sewed up or plastered over. Others are more humanely killed before this process is performed.

In India, as we have elsewhere said, rice is the general food of all classes; and in fact in all Southern Asia, with herbs, vegetable oils and fruits, it constitutes the almost exclusive aliment. The Hindoo lives and works on 1¼ lbs. of rice per day, with water, for his drink; travelling with coolies, or passenger cars, with 500 lbs. weight, fifteen miles per day. No one of caste, it is said, ever partakes of beef; and none but out-casts are intemperate in stimulating drinks. The principal luxury of the mahomedans is fruit.

The Chinese subsist chiefly on rice, a kind of cabbage, and a few other culinary vegetables. Swine, or pigs, and ducks are the principal animal food, and these are necessarily sparingly eaten. Dogs, rats, and almost every other animal, is eaten with avidity when they can be procured. Fish are caught on the coast and in the rivers, and these contribute a little to the animal food. The rich, as a luxury, eat soups made of bird's nests, slugs, &c. Tea, cold and without milk or sugar, is the chief drink, and opium affords them a source of baneful luxury.

The Japanese are less fed than even the Hindoos: they refrain both from animal food and milk, though those upon the coast are said to be provided with fish and fowls. They use considerable tabacco and their principal drinks are tea and rice-beer.

In Sumatra, Java, Borneo and the Phillipines, the diet of the people is

also simple, it being mostly rice and fish, taken on the coast, and fruits. Maize is some eaten in Sumatra. Wine and spirits of their own make are much drank. The latter, called *bang*, is extracted from hemp. Opium and tobacco are indulged in to excess.

The Tartars, like the Arabs, are a wandering people; but, instead of the camel as the source of nutriment, they subsist chiefly on horse flesh. The animal is carefully fattened for the food of the more wealthy, but the value of the horse renders the food scarce with the poor, particularly in winter. Sheep are however considerably eaten. Few vegetables or fruits are cultivated or eaten. Considerable mare's milk is drank, but more is fermented into an intoxicating drink.

The Siberians, in the north, obtain their food mostly by hunting and fishing, though in the south of their country the grains are abundant. Sour milk and horse flesh are also chief articles of consumption. They have no knowledge of raised bread. The greatest delicacy is fat, raw, melted or rancid. A soup is made by them of the inner bark of the larch tree; milk or fat is likewise consumed in considerable quantities. Fresh fish are eaten in large numbers, and the flesh of the Reindeer is much esteemed. Their dogs are said to eat the same food as their masters, while those of the South Sea Islands in doing the same, are seen to eat nothing but vegetables, yams and bread fruit. Tobacco is a luxury in the northern parts, inducing stupefaction by the smoke being swallowed for that purpose.

The Norwegians are well provided with rye, as their bread corn; the bark of the larch with the meal of rye, barley or oats is also much used as bread. Their chief animal food is fish taken in great abundance on the coast and in the bays. 2,650,000 tons of grain are annually raised in Norway, and 750,000 tons are imported. The dairy products are abundant and much exported. Coffee is much drank, and even to excess by the women.

In Sweden the agricultural products are abundant and great quantities are exported, though thirty years since the quantity was insufficient for their own consumption. The grain grown in 1828 was 6,499,000 tons and 3,248,000 tons of potatoes. The neat cattle are estimated at 1,900,000 and the sheep at 1,562,000, yet a fifth of the people are said to be unable to support themselves.

In Denmark the chief vegetable food is rye, buckwheat and potatoes. Wheat is in the proportion only of half a bushel for each person. Fish and beef are largely eaten. Barley is the chief grain of the islands. This, with oats and buckwheat, forms the bread of the people. The products of the dairy are here also abundant. Denmark has exported in six months 4,671,260 lbs. of butter and 596,100 lbs. of cheese. The "Hamburg beef" so famous, is from Denmark.

In Mecklenburg, and other near duchies, the food is like that of the Danes. The consumption of persons on a farm has been estimated at

two-thirds of a bushel of wheat, ten bushels of rye, with barley, peas and meat; and, for a family of eighteen persons, 144 bushels of grain, six bushels of peas, one ox, four cows, ten sheep, with some herrings.

In Holland the products of the dairy and potatoes are the chief support of the people. Potatoes constitute almost the entire food of the people of the eastern and northern provinces. The peasants add a gruel made of oats or rye, and they are afforded salted meat once or twice a week. Their bread is chiefly rye. Cheese, buttermilk, beans, buckwheat, with a proportion of garden vegetables, and occasionally pork, are eaten by the farmers and a part of the artizans.

In Belgium grain and live stock are considerably abundant. Rye is the principal corn bread; it is to wheat as 2 to 1, the same to oats, 7 to 2 of barley, to 2 of buckwheat, to 1½ of potatoes, and 1 of pulse. Buttermilk, with rye flour, is a favorite dish with farmers. The animal food is mostly pork and salt fish. Milk and cheese, with vegetables, butter or lard, a weak beer, and occasionally fish and flesh, are the common diet in the country. Beans stewed in milk are much admired. Rye affords the principal bread of all the north of Germany. In the south, wheat is raised to considerable extent, with some maize. The great body of Germans are said to be decidedly a pork eating people, and the principal vegetable is cabbage. Bacon, raw herrings, sausages, with beer or sour wine, constitute, with these, the bulk of the food of the German family of thirty millions. Still, the poor obtain meat of no kind oftener than once or twice a week. Eight millions of hogs are said to be annually slaughtered in Germany. The sheep have been estimated at twenty millions and the neat cattle at over twelve millions; Prussia, west of the Elbe, having 1,328,000, and Austria 2,800,000.

In Russia, rye and oats are grown abundantly in the northern, and wheat in the southern provinces. Yet the mass of the peasantry are otherwise poorly fed. Barley, rice and maize are also cultivated in some parts. The chief food of the farm laborer is rye bread, buckwheat, sour cabbage soup, with a few vegetables, and occasionally fish and sometimes flesh. The more wealthy have salt fish, cheese, honey, &c. In Poland the food is very similar.

The truth and purport of the remark that, "wherever a loaf is added, there's a man born," is every where observable in the increase of health and population. All the variations in mortality are seen in Europe to be produced by the price of bread. These facts should induce a comparison between the mortality of our countrymen and Europeans. Improvements in the arts of agriculture and the consequent increase of vegetable and animal food in some countries of Europe, together with the laws applicable to food, accounts for the gradual increase of population, as may be observed in France. The increase of

the population of Ireland is also justly attributable to the extended cultivation of the potato.

It need not be argued in this place, that in this country, the great abundance of both vegetable and animal food is the chief cause of its prosperity, its rapidly increasing population, and the comparative health and energy of the people. Our country, under these circumstances, in connection with its free institutions, cannot be otherwise than prosperous and powerful, if the rapid developement of this power and prosperity does not itself disturb the clear current and check the steadily onward tide of their progress. This, we are free to say, is mostly to be apprehended from the mingled population flooding our shores from all countries, and in general consisting of those little qualified from previous habits, prejudices and ignorance of letters and of our institutions, which are prematurely pressed under their control; to appreciate and perpetuate the purity and variety of our natural, political, civil and religious blessings. Whilst this is desirable in the extension of the advantages we enjoy, of health, freedom and happiness; in the additions to our numerical strength and in the more rapid developement of our resources; yet the influence of political power made to accompany the advantages thus afforded, necessarily hazards the purity and prosperity of those blessings, as time has already revealed and will hereafter reveal in demonstrations not to be mistaken by the most reckless political demagogue.

INTOXICATING VEGETABLE JUICES.

As intoxicating drinks of all kinds are the products of vegetables and essentially connected with our subject, we may be expected to make some general remarks, in addition to what has been heretofore incidently said on this important subject—important from the controlling influence it exerts on society, on the happiness, the intellectual and the moral condition of mankind. These products are chiefly from the cereal grains, which, as we have just seen and as all must well know, are the most valuable of the vegetable world. The singular anomaly is therefore presented of their being at once the greatest blessing and the greatest curse of mankind. No fact can be presented to the mind, therefore, so fully illustrative of what we have before said and what we wish could be more deeply impressed on every mind —that it is the *abuse* of the blessings of nature which is the great source of evil and crime in the world.

But it should be understood that alcohol does not exist as an element in vegetable substances. It does not exist in the sugar or the starch of the grains nor in the grapes, when whole; it is the result of the act of fermentation and of the arts of men that the elements are changed and spirits are produced. Nor will the juices ferment if kept from the air. Starch is free from any thing like alcohol, but kept moist

for some time it is gradually converted into sugar, and by fermentation undergoes such changes as convert it into alcohol. It is therefore apparent that the author of nature designed no such perverted use to be made of vegetable productions.

The Intoxicating principle of vegetable juices is alcohol, whether found in distilled liquors, fermented wines, beer, cider, perry, or others of the many compositions in which ingenuity has concealed that principle. It is a poison to the nerve applied externally or internally.

Opium, too, is a poison, and one of the most active of the vegetable kingdom; yet, like alcohol, in some cases, it is medicinal. We have, however, spoken of alcohol in another place. It is the *use* of these things in all cases which is to be considered; and it is the obvious use designed in their creation by a wise and Beneficent Being that alone gives them, with all other substances, their value to man and animals.

Most happily the wisdom of the present period views alcohol in a more just and rational light than formerly. The judgment of men has become convinced, though the natural taste may not be otherwise changed; and the consequence is, as may always be expected under like circumstances, the one has triumphed over the other. This conviction of the judgment, it should be remarked, is the only certain and efficient precursor of good. Rum and brandy, gin and whiskey, beer and wine drinkers have become convinced, we say, of the evils which necessarily flow from their use, and hence the progress of the popular achievments in temperance, and hence men cease to abuse the blessings of vegetable nature, as well as the health and existence of their own.

The process of fermentation does not take place in nature so as to develope alcoholic liquors; but it is the result of art. The making of wine and beer, as with the distillation of molasses, consists in numerous and elaborate artificial processes. In brewing there is grinding, mashing, hopping, boiling, cooling, cleansing, fining, attenuation, &c., in all of which great care is necessary. In wine making the processes are equally numerous. Grape juice might pass, by a natural process, if the grapes were prepared, into the vinous fermentation; but it would almost immediately pass into the acetous fermentation and form vinegar. This, indeed, would seem to be *the* natural process. It is not a natural process for barley to form beer any more than it is for the farina of the seed to form beer in passing into sugar in germination, for the support of the young plant. Wine, therefore, is the *manufactured* liquor of the juice of the grape, and beer is the *manufactured* liquor of barley, and not, as some would believe, the result of natural processes.

The composition of grape juice consists in sugar, extractive matter, gum, glutenous matter, malic acid, citric acid, cream of tartar, etc.; and wine is alcohol, water, tartaric or malic acid, extractive matter, etc. Carbonic acid is found also in the effervescing wines, blue color-

ing matter, tannin, etc. in the *red wines*, and sugar in the *sweet wines*; volatile oils and 2 or 3 other acids are likewise found in some wines.

Beer is composed of a large proportion of extractive and mucilaginous matters derived from the malt. The nutritive properties, as compared with the barley, or even the malt, are very small, not amounting to a fourth part. An analysis of North River Beer shows that a pint contains 816 grains, or a 11th part of extractive matter. Beer, like wine, has a tendency to pass into acetous fermentation, but is restrained by the bitter principle of hops. In the infusion of malt, the gluten of the grain acts as a ferment to the saccharine part. Both wine and malt liquors resemble each other in being the product of sugar with water; they are decomposed by yeast or gluten; and alcohol and carbonic acid always result.

The ultimate constituents of alcohol are carbon, oxygen and hydrogen. These we cannot unite so as to form alcohol; and fermentation is therefore resorted to, which extricates these elements and unites them in a new compound. By distillation this new compound is evolved, diluted with water and associated with essential oil. This oil is afterwards separated by *rectification.*

The alcohol of wines is procured from them by distillation; or it may be obtained by adding *subacetate*, or sugar of *lead*, which throws down the acid and coloring matter; and then, by adding dry sub-carbonate of potassa, the alcohol is brought up to the surface. This alcohol is present, as we have said, in all intoxicating drinks.

The effects of alcohol are proved by chemistry, physiology and experience to be pernicious and destructive. It is opposed to digestion, retarding the conversion of articles of food into chyme and also the conversion of this into chyle. It has no reducing power, like water, by which the food is dissolved; but, on the contrary, it coagulates the albumen and hardens the muscular fibre of flesh taken into the stomach, hence its use in preserving animals in natural history. Beside this, it is proved to render the gastric juice inert. If these results are not perceived at once on the introduction of spirits, beer, wine, etc. in small quantities, they are nevertheless certain. All the processes therefore of digestion and assimilation are impaired or destroyed by it.

Nor do these truths depend alone on science, the health of the living or on facts after death—any one of which should be satisfactory—but on immediate observations, as *seen* during life, in the stomach, in the case of Martin, as reported by Dr. Beaumont, who says the use of ardent spirits, wines, beers or any intoxicating liquors has invariably produced these morbid changes. It is folly therefore to assert that any alcoholic drinks promote digestion. Wine and beer, drank in health under any circumstances, comes within the category of alcoholic drinks and the evils we have noticed. Both produce drunkenness taken in larger quantities than spirits, and both manifest all the

other accompanying and resulting effects of alcohol so apparent to all who are not interested observers.

Adulterations are causes, too, of still more alarming evils, if possible. In view of these, in beer drank, as we have mentioned, in such immense quantities in England, it has been said by British writers that "*the taste of the people generally is so vitiated by the adulterated; in fact poisonous beer, ale and porter, that even if the brewers were all honest, they would not find customers for their purer liquors.*"

Consumption of alcoholic spirits.—Something of this will have been seen, but the amount shipped from one port in Spain, Barcelona, in the form of wine and brandy, affords one of the elements of estimates we propose to add. These exports were to Cuba 12,000 pipes of wine and 3,000 pipes of brandy; to South America 16,000 pipes of wine and 6,000 pipes of brandy; to the North of Europe 2,000 pipes of wine and 2,000 pipes of brandy—total, 60,000 hogsheads, or 3,780,000 gallons of wine and 22,000 hogsheads, or 1,638,000 gallons of brandy—grand total, 5,418,000 gallons. Calculating a pipe of brandy in every three pipes of wine, there was 46,000 hogsheads, or 2,898,000 gallons of brandy.

To the large amount of brandy for the English and American markets, drugs of various kinds are almost always added; and after they are received they are still more and still worse adulterated. The accounts of these adulterations, both here and at the places where the wines are made, are revolting. Of Champaigne it is said that not one in one hundred of the bottles drank, here or in England, come from Champaigne. It is therefore confidently asserted, in comparing the wine and grog drinkers, that the advantage, so far as health and longevity are concerned, is in favor of the grog drinker.

Intoxicating liquors in France are chiefly wines, brandy, beer and cider. These, in 1830, were in gallons respectively as follows—Wine 611,466,000; Cider 234,121,000; Beer 124,000,000; Brandy from wine, &c., 15,074,000; Brandy from cider, cherries, potatoes and grain 2,890,000—total, 987,551,800 gallons! The amount exported, however, is large. It is now estimated that there is annually made in France 141 million galls. of brandy. The quantity of intoxicating drinks consumed there has been estimated in the proportion of 32 galls. for each of 32,500,000 persons—the population of 1830.

The amount of beer in France is also enormous. The excise duties on beer alone in 1824 were $1,800,000. The use and manufacture of beer and cider are chiefly in the north of France. The amount of alcohol in Burgundy wines is estimated at from 8 to 10 per cent., and by Brande at 11 to 16, and Champaigne at from 12 to 14 per cent.; Claret at 15, and the common country wines from 4 to 5, and cider at from 7 to 9; strong beer (which forms four-fifths of the malt liquors made in France) 5 to 8, and Brandy 50 per cent., so that the sum total of the

alcohol drank or produced annually in France, at a low estimate, is 86,570,870 or more than 2½ gallons for each person. Deducting, as consuming none of this, one-third of the population for children under twelve, and say all the women, which is scarcely supposable, and there will be consumed by each of the 10,167,000 males over ten, between 7 and 8 gallons of alcohol. But from this should be deducted, say one-third for exportation, and the amount then consumed by each would be above five gallons. This, though not so apparent in its effects to a stranger as in most other countries, is said to be appalling to residents, especially in the north of France, where it is chiefly drank. Drunkenness is said to be the curse of the laboring classes; and of the insane, it appears that a large proportion are made so by drinking wine.

Intoxicating drinks in Great Britain we have briefly noticed, but to make a comparison we might repeat that the amount of beer drank, as stated, is 9½ millions of barrels, or 342 millions of gallons. The amount of alcohol in this, at five per cent. is 17,100,000 gallons. The amount of cider drank is estimated, for 1830, at 4,725,000 gallons, the alcohol of which, at 7 per cent., is 330,750 gallons; the ardent spirits drank, say in 1830, was 27,708,831, the alcohol of which, at 50 per cent., is 13,854,415, and the wine 6,434,445, the alcohol of which, estimated at 20 per cent., is 1,286,889, making the total of gallons 380,868,276, or near 16 gallons for each person. The total of this in alcohol is 32,572,054 gallons. Taking the population of 1830 at 24,500,000, and one-third as males over twelve, as estimated with the French, and the amount for each of 8,333,500 persons will be over four gallons. But this does not include the amounts produced by the great numbers of private breweries.

"Drugged beer and spirits," it is said, "constitute the staple drink of the great body of the people, especially in the metropolis, where it is rapidly accelerating their degeneracy." The excessive use of intoxicating liquors in Ireland has been a revolting evil, but the late encouraging progress of temperance there has most happily produced a remarkable change, whilst in England little, if any change in this respect has been, or from appearances is likely soon to be effected.

The amount of alcoholic drinks in the United States may be determined as follows. There were produced in 1840, 41.402.627 gals. of distilled liquors; 124.734 gals. of wine, and 23.267.730 gals. of beer. The value of spirits, of grain and other materials imported was $1.592.564, of that of molasses $2.910.791. Of beer, ale and porter $135.485, and of wines $2.209.176.

Calculating the above amount distilled to be of spirits 36.343.236 gals. and the alcohol at 50 per cent., this would be 18.171.618 gals.; also the amount of foreign spirits at 2.500.000 gals. and the alcohol at 50 per cent. would be 1.250.000 gals. Calculating also the wines imported at 4.000.000 gals. and the alcohol at 18 per cent. and the do-

mestic wines as above at 12 per cent. the alcohol of the two amounts of wine would give 734.494 gals. Add to this the alcohol of the beer produced and that imported at 5 per cent. (estimating the latter at 7.000 gals.) viz. 1.163.736 gals. and the total of alcohol is 21.319.848 gals. This, taking a third of the population as consumers, say 5.730.-000, would be about 3¾d. gals. each. But by estimates made by Dr. Bell, the amount drank in 1830 must have been more than treble this, and greatly exceeding the consumption in England or France.

Beside these estimates, the amount of cider drank, with 7 per cent. of alcohol, would probably increase the latter to four gallons of alcohol for each individual of the above proportion. But the remarkable decrease in the consumption of intoxicating drinks since 1840 will have reduced this amount of alcohol, at a fair estimate to 3½ gals. as the proportion of each person at the present time; and since 1830, the decrease has been, according to other estimates for that year, *more than three-fourths!* These facts are indeed encouraging to the friends of temperance in this country.

The whole amount of the above mentioned liquors, as per returns for 1840, and other estimates as above for that year, is 71.295.791 gals. This allows near 13 gals. for each individual of the above proportion of our population. The quantity of wine for each is 2.4-5th quarts.

The number of breweries in the United States in 1840 was 406; and of the 23.267.730 gals. brewed, 12.765.474 were in Penn.; 6.059.122 in New-York. There were also 10.306 distilleries, and of the 41.402. 627 gals. of products, 11.973.815 were in New-York; 6.329.467 in Ohio; 6.240.193 in Penn. and 5.177.910 in Massachusetts. Capital employed $9.147.386.

It has been remarked that the prodigal supply of esculent vegetable food which abates the thirst excited by animal food and of the fine fruits of America, of which all can partake, afford less excuse for us than for others who seek to vary the pleasures of the palate by fermented and distilled liquors. The exciting property of the air of our climate, also, with the natural excitable temperament and incessant activity of our people, afford less inducement for physical stimulants than with most others. "The young and spirited horse and even the well-broken courser require the rein and the bit more than the spur. We, of all people on the face of the earth, want brief snatches of calmness for meditation and revision, but no goading."

Fermentation.—This is the spontaneous change which vegetable juices undergo under certain circumstances, terminating in the production of alcohol by *vinous*, or vinegar by *acetous* fermentation. A third species of fermentation is the putrefaction of animal substances. An elevation of temperature is always necessary. This, in the vinous process, with some juices, proceeds just above 32°, but best between 50° and 70°; if much higher the acetous fermentation may be excited.

No vegetable juice can be made to undergo the vinous fermentation without sugar and a certain fluidity. This sugar comes from the malt in brewing, and in wine-making from the grape; from the apple in cider and the pear in making perry. Most juices go into vinous fermentation soon after being exposed; but artificial solutions of vegetables, as with malt, require yeast to begin the process. To complete vinous fermentation the juice should come from ripe fruit, in which sugar is most abundant, and the flavor is best. With unripe fruit fermentation is imperfect.

Honey nor sugar ferment without the fluidity of water. All parts of fermenting liquors do not ferment at the same time; the slowest are the poorest. The first fermentation being checked, the suspended parts are separated, as *lees* and the acid salt *tartar*. If the sugar be small the fermentaton soon ceases; and the liquor exposed to air commences acetous fermentation by the absorption of oxygen from it; the result is *vinegar*.

Wine is the product of the vinous fermentation of the grape juice; and much skill is necessary to regulate the process. The quality depends on the sugar and the odoriferous matter contained in the grapes. If these be sufficient and the fermentation is carried to the exact point, the wine is good. If the sugar be in excess, the excess remains; if deficient, the wine is thin and weak. If bottled before fermentation is complete, it continues to disengage carbonic acid gas; and when the cork is drawn, it sparkles, as with Champaigne, &c.

Few wines possess much flavor or color; but both of these are furnished by the manufacturer, to suit taste and profit. Bitter almonds, oak chips, wormwood, rose-water, &c., supply the first, and dye-woods, iron, &c., the last. The kinds of wine are the *astringent*, *dry*, *sweet*, *foaming*, *sparkling*, &c. The last is generally to be avoided. Bordelais are most wholesome of *light wines* and Madeira of the *strong*. *White wines* are from white grapes and *red* from purple, crimson and black grapes, with the husks, which contain the color, aroma and tannin, or astringent principle. These are salutary, if the husks be used; but they are wanting in white wines, which contain most alcohol. Of the nine of these, Malaga is sweetest and Hock the most acidulous. Much of the port wine is said to be made with Brazil rum, logwood and rhatany root. More vessels leave Oporto with wines than the whole of Portugal can produce. The Champaigne and Burgundy are the best of the French wines. The Rhenish, or Hock, is the best of the German wines. Malmsey is made from Muscadine raisins. The varieties and peculiarities of wine are, however, too numerous to describe here.

The method of making and fining wines is worthy of notice. Red wines in the south of France are made by treading or by squeezing grapes with the hands. The juice and husks having stood a time are

pressed; but for white wines these are pressed immediately. They *tun* the juice or *must* and leave half a foot for the wine to work. The wine and husks sometimes stand two days for white, and a week for claret wine before they tun it. To *fine* it, shavings of green beach are put into it. If impurities remain, isinglass, powdered alabaster, roch-alum or sulpher, &c. are added. Domestic wines may be made of raisins, currants, elderberries, gooseberries, &c. with sugar and spirits. *Tokay wine* is made in a volcanic district and is famous. Genuine port is rarely met with in this country. The briskest wines keep the poorest. *Meregout* or mother drop, is the virgin wine running from the top of the vats before the grapes are trodden. *Draught wine* is made of husks left of grapes by throwing water on them and pressing them again.

The goodness of wine consists in its being net, dry, clear, brisk, without taste of the vessel, with a clear steady color, strong, but not heady, a body without sourness, and in keeping without growing hard. But the vocabulary of terms and shades of quality are quite unnecessary here. Cider will be noticed under apples, perry under pears, and other drinks under appropriate heads.

DISTILLATION.—*Rum* is obtained by the distillation of the juice of the sugar cane, or molasses. It contains much alcohol and a gross essential oil. This is called in the United States *New England rum*, being mostly distilled there, and is largely exported. *Jamaica proof*, or *low wines*, is the same but stronger, so that oil will sink in it.

Brandy is a distillation of wines or of coarse fermented grape juice. The still is filled with the liquor and a slight heat applied till the sixth part passes over, or till what runs into the receiver is not inflammable. It is colorless; the dealers give it its color; and its peculiar taste is given by the addition of an essential oil. Brandies are principally prepared in France. That shipped from *Cognac* and called *Cognac brandy* is most esteemed. They are prepared in numerous ways with strong liquors, sugar, spices, flowers, fruits, &c. Olive oil, or tallow, will sink in the best brandy. Burnt sugar is added to give mellowness, color and flavor. When first used, brandy was greatly extolled as a medicine, a sovereign remedy and elixir of life.

Spirit of wine is colorless and very inflammable. It is obtained chiefly from fermented malt liquor called *wash*, but formerly from wines. In its purest state it is alcohol, and is one of the lightest liquids known; a pint weighing, or it should weigh, 13¼ oz.; 95 parts being of alcohol and 5 water. It is much used in medicines and the arts.

Proof spirit is colorless and inflammable. A pint should weigh 15 oz. 55 parts being of alcohol and 45 water. Brandy was considered proof spirit; but this is now made by the addition of water to spirits of wine. It is used in the arts and in medicine.

Gin, or *Geneva*, is a compound made of juniper berries or oil of

turpentine and distilled with malt spirits. Angelica root and other aromatic vegetables are also often added. The common hot and pernicious gin is, or has been, much used as a dram.

Arrack is a spirituous liquor imported from the East Indies, and is considerably drank in Europe as a dram and in punch. This Indian name means *strong water*, as all ardent spirits are called by the people of India. It is procured by the distillation of a vegetable juice called toddy, flowing from incisions in the cocoa nut tree, or by the distillation of rice, fermented with the juice of the cocoa nut tree. The *Goa* arrack is said to be made from the toddy, and the Batavia from rice and sugar; it is also made from a shrub. A spirit like this is made from the juice of the maple tree which is said to taste like that of the cocoa tree.

Whiskey, formerly meaning water, is a strong liquor distilled in Ireland and Scotland from wheat, rye and maize. From thence it has spread abroad. *Potsheen* is the kind of whiskey distilled in the hovels of Ireland. *Mountain dew* is a kind distilled in Scotland. Whiskey is much distilled in the United States.

Malt is made by steeping barley in a stone trough full of water till the water is red or till the grain is much swollen and soft. This being taken out is laid in heaps till the water is drained, then turned into a new heap. In 15 or 16 hours the grains put forth roots; and this is done in 40 hours. The malt is then turned over and spread five or six inches deep, then turned over and over for 48 hours. It is then thrown up into a heap where it grows as hot as the hand can bear it, which is done in 30 hours. It is then spread, turned and cooled and laid on a kiln, upon hair cloth or wires.

These processes require about 14 days. The drinks made are *pale* or *brown*, as the malt is more or less dried on the kiln; the least dried tinges the liquor least, or is *pale*, and that dried most, or roasted, gives a higher color. Coloring drugs, &c., are used to give color when the malt is poor.

Brewing is the preparation of ale or beer from malt. A quantity of water being boiled, is cooled to 175°; the malt is mixed and stirred; a few handfuls of dry malt being reserved are now spread over the mixture to retain the heat and the vessel is covered with cloths; this is *mashing*. The whole stands about three hours, when the liquor or *wort* is drawn into a receiver. This mashing is repeated with the grain for the second wort. On drawing off these worts a quantity of hops is added to them, and the liquor is again boiled, then strained, cooled and barm or yeast is then added, which causes it to ferment; after which it is *tunned* up in vessels for use. Two or three months time is required before it is fit for use. Ten bushels of malt are necessary for a hogshead, or 54 gallons, of strong beer, and five bushels

for one of good ale. *Hops* are said to preserve malt liquors from souring.

There are numerous other kinds of alcoholic drinks obtained from different vegetables, which we have noticed under the heads of the respective plants or fruits from which they are obtained.

COMMON AND IMPORTANT BEVERAGES.

Numerous vegetable substances are added to water for the purpose of drinks, or beverages. The juice of many fruits are common additions for this purpose, especially in warm climates. These are refrigerating and allaying to thirst. The citric, acetic and tartaric acids are mostly used. Lemonade is a well known drink used for these purposes in warm weather in this climate. Infusions of apples, tamarinds, currants, cranberries and preserved fruits of various kinds are also much used. Vinegar, with sugar or molasses, are likewise frequently drank. Pleasant beverages are made, in fine, of most of the native fruits of our country, containing sacharo-acid principles. A feeling of heart-burn or acidity of the stomach, is said to be occasioned more frequently by the compound juices of fruits than when acids are alone. Thus orange juice often disagrees with the dispeptic, while that of the lemon, with sugar, is grateful and not inconvenient in its effects. Cider, or wine, also gives rise to these feelings, while vinegar with water will often relieve them. Sugar and water is a common drink with the French. Sugar candy allays thirst and is often nourishing.

But beverages most extensively drank are made by the infusion of herbs of different kinds and the coffee berry. Common aromatic and bitter herbs, such as balm, sage, &c. are considerably used as teas. The gums, though devoid of taste and stimulating qualities, are soothing; and thus quench thirst better and for a longer time than water. A good mucilaginous drink is thus made of gum arabic, which may be administered in cases of fevers, allaying thirst and avoiding the want of water. The desire for all these drinks ceases with the quenching of thirst, having no stimulating properties to induce a habit of frequent drinking. We have already alluded to rice and barley water, &c. But of all the beverages used, that made of the tea plant and of coffee is the most common, and these therefore merit special notice.



TEA, *Thea*, or as it is called by the Japanese, *Teah*. Camellia, (or Linn. Columniferæ, or Juss. Aurantia.) C. 16, O. 7, sp. 6-8, Es. 4 ft. (Some place the tea tree in class 12.) This is a plant greatly cultivated in several provinces in China, Japan and Siam, an infusion of the leaves of which constitutes the well-known drink, *tea*. The roots resemble those of the peach tree; the leaves are green, sharp at the point, narrow, 1½ inches long and jagged all around; and the flowers are white and like those of our wild rose. The fruit is a berry of different forms, round, long

or triangular, of the size of a bean, and the pods contain 2 or 3 peas each, with a kernel. These peas are the seeds sown. *Thea bohea*, or *Bohea tea* plant and the *Thea viridis* or *Green tea* plant are those distinguished by botanists; but there are other species and many varieties, as the kinds we receive indicate. Some maintain that there is only the latter species.

The tree, as it is called, is a branchy evergreen shrub, from three to five feet high, though one species is a tree forty feet high. The leaves are gathered when they are nearly full and juicy, in April, June and September, and are passed, some say, over the vapor of boiling water and dried on porcelain plates, by which they curl up, as we find them. But tea is rarely free from the admixture of other herbs, such as moss-ferns, &c., with the *olea fragrans* to give it flavor. The price there is usually from five to eighteen cents per pound. The Chinese know nothing of the many names by which tea is distinguished in Europe and this country, or of its advanced price. They have, however, distinctions of their own, such as *voui soumlo*, etc., which are used by those of rank and the sick. Tea has been cultivated by them from immemorial time, and sung by their poets since the time of Confucius. The poor, however, often beg the steeped leaves of strangers, which they say makes a better drink than that which they commonly obtain.

The common tea of the Chinese is the green, or "bing tea," gathered in April, and the *bou*, or bohea tea, which is gathered while in the bud in March, as seen from its small leaves and deep tincture; but others attribute this to the district in which the plant is grown; and the color of the green tea to both place and time of gathering, which much affect the quality and appearance. The Chinese make and drink tea as we do, except that they use little or no sugar and no milk to temper its bitterness, as is done by us. The Japanese pulverize it, stirring the powder into hot water and drinking it as we do coffee. The former regale their friends with it and take it three times a day, or oftener, though they consume a less quantity in proportion to numbers than Europeans.

The species of tea are the *camellia bohea*, or bohea tea, C. viridis or green tea, and C. Japonica, (Japan Rose,) which is a lofty and beautiful tree growing in gardens in Japan; and there are twenty garden varieties. The C. viridis is undoubtedly the species chiefly cultivated and which furnishes the tea of commerce; but this is much and variously adulterated with the other species and poor varieties, and especially by the leaves of other plants, to which is added the oil of the seeds of the C. oleifera to improve their quality. This latter species is much cultivated in China and Japan for the oil of the seeds which, when expressed, is there used for many culinary purposes, like that of the hemp and poppy seeds. The seeds of all the species likewise afford this oil. The *Black teas* are the bohea, congo, campo, souchong, pouchong and pekoe. The green teas are the twankay, hyson-skin,

young-hyson, hyson, imperial and gunpowder. These varieties are placed in the order of their relative value from the lowest upwards. About a dozen kinds are quoted in the Hamburg and New-York markets, but only six or seven in England.

The principal sorts in China are called from the places where they are grown, and others are known by the periods at which they are gathered, the mode of curing, &c. The five kinds of bohea are named from the mountain Vou-yee, covered with tea plantations. The first crop of leaves here is *Saatyang* (souchong) and *Pekoe* or *back-ho*; the second gathering, when the leaves are more mature, is the *Kong-fou*, or more common bohea tea. The province whence comes the green tea affords the *Poa-sut-tcha*, or padre-souchong, which is there esteemed for its supposed medicinal virtues. The three kinds of green tea are called *hayssuen*, or hyson, and consist of leaves carefully picked and dried with less heat than other sorts and costing a fourth more than souchong. The kind most abundant is called *Singlo*, from the name of a mountain on which it grows, 150 miles from Nan-king. The gunpowder tea consists of tender leaves rolled in the hand into the form of a ball, which sells for 15 per cent. more than hyson.

There are green and black tea districts; and the various qualities of tea chiefly depend on this, the time of gathering and mode of preparation. The first crop is gathered about the first of April when the leaves are young and tender. These have an aromatic flavor, and are the *imperial tea*, often used on great occasions in China, and reserved for the wealthy. They consist of buds and half expanded leaves which, though strong, scarcely color the water. The 2d gathering is early in summer when the leaves are full size. And the 3d crop is made in autumn. A 4th gathering is also sometimes made. The two last crops are of an inferior quality. The Chinese are said not to use their tea until about a year old, it being considered too strongly narcotic. It has acquired little less age, indeed, when brought to this country. The East India Company are obliged by their charter to have on hand at their London warehouses a supply for one year's consumption.

The cultivation of tea is mostly prosecuted in the eastern parts of China, called "the tea country," between lat. 30° and 33° N.—some say 27° and 31°. The plant prefers and succeeds best in valleys or the side of mountains with a southern aspect and a light, strong soil, consisting chiefly of red sand-stone and granitic rocks. The leaves of plants must be exposed, and those from young wood are always the best. Seeds are grown some in hot houses in Europe and this county, in sandy loam and peat. Those of the species C. sassanqua are used to produce the female plant for new varieties. This plant may be successfully cultivated in parts of Florida and Texas, no doubt, by slave labor. A plant has recently been discovered in Texas which

is said to resemble the Chinese tea-plant very closely, both in appearance and quality. Attempts hitherto made to cultivate the tea-plant elsewhere than in the places named have however failed, except in Java, chiefly from the difference in price of labor. The climate of Brazil is very favorable, but the cost of labor has frustrated the attempts to cultivate it there. That the leaves of many of our domestic plants may be used as a good substitute for tea, except so far only as the fancy and caprice of the drinker is concerned, we cannot doubt. The young currant leaf is thus considerably used as a substitute, and very frequently without being recognized.

The mode of cultivation and preparation are to plant 7 or 8 seeds in holes 4 or 5 feet apart in rows; this number of seeds being necessary from the uncertainty of their vegetation. The plants then require little further attention, except to keep out the weeds. In 3 years they furnish a crop of leaves and three crops annually thereafter. In 7 years they acquire their height and are then trimmed down or removed and new ones planted. The leaves are picked one by one; and from 4 to 15 lbs. are picked daily by one person. When gathered they are exposed to the air or sun a few hours and then taken to houses having from 5 to 20 small furnaces, 3 feet high, each having upon the top a flat iron pan. This being heated, a pound or two of the leaves are thrown on it, when they quickly curl up. They are then removed with a small shovel to a long table covered with mats and surrounded by workmen who rapidly roll small quantities in their hands in one direction, while others fan them that they may cool and retain their curl.

This is sometimes repeated 2 or 3 times, or is repeated after the tea is sent down to Canton; the tea is then carefully picked over. With finer sorts the heating is often dispensed with, and each leaf is rolled with the hands into a small ball. The tea is then winnowed; that falling nearest the machines is the heaviest and best. When brought to Canton it is there often winnowed and afterwards packed and stored.

The properties of tea have long been a subject of discussion. From analytical experiments made at the Royal Institute, London, some time since, no deleterious properties were detected in green or black tea; nor has a trace of copper ever been found. An analysis of black and green tea gives results as follows:

	Black.	Green.
Tannin	40.6	34.6
Gum	6.3	5.9
Woody fibre	44.8	50.3
Glutinous matter	6.3	5.7
Volatile matter and loss	2.5	2.5

A crystaline solifiable base called *theina* is said to be found in tea, though this is thought to be identical with *caffein*. Still, some have

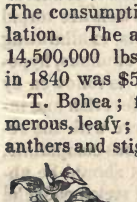
maintained that bad properties exist, and that, in a highly concentrated state, the decoction is very poisonous. The injurious effects of drinking tea, however, if any, may be attributed, we apprehend, more to the hot water in which it is drank than to the qualities of the tea. Tea is a mild narcotic, and like all narcotics in small quantities, is exhilarating; the green tea is more especially so. It acts as a diuretic and diaphoretic; and it assists digestion.

Most nutritive and valuable vegetables, when their properties are obtained in a highly concentrated state, are deleterious to man and animals, are narcotic, acrid or poisonous, as with the potato, the fermented juice of the grains, &c. The most poisonous of vegetables are among the most valuable of medicines, and immediate death follows their use in some cases, while in others they restore health and nourish the body. The astringency of tea has acted as an antidote to the effects of poisons from vegetable alkalies. Where the bowels are torpid or costive, tea of much strength should be avoided. Its exhilarating effects on the nervous system has recommended it to the studious, hypocondrical and dispeptic, though, like other excitants, it is followed by more or less depression. It has been recommended in feverish and inflammatory diseases, though its effects should not interfere with the required sleep of the patient. To those affected with nervous complaints, palpitation of the heart, or great functional disorders, it should be abstained from. A knawing at the stomach, vertigo and sick headache are said to be sometimes referable to its use; but we apprehend these last are seldom. Plethora or morbid fullness and excessive excitement of the brain are diminished by its use, and it is therefore better adapted to those of fleshy habits than to the thin and nervous. Green tea in its effects is more stimulating and occasions ill effects where black tea is devoid of this or any obvious effects.

It seems in too many cases where the use of particular vegetable food or drinks have been loudly condemned that the declaimer is disposed rather to quarrel with the gifts of Providence than to condemn the *undue use* of them. It is the *abuse* of such and of other productions, laws and blessings of nature, we repeat, that is baneful, or which constitutes crime. The argument is that if these are deleterious in one state they must necessarily be more or less so in all others; but the falacy of this is shown in their medical use and in the application of the principal to *all* vegetable products. The introduction of tea and coffee may be said to have produced the greatest change that ever took place in the diet of civilized nations. They afford stimulus without producing intoxication, and the lovers of these beverages are rarely excessive drinkers of ardent spirits. The use of tea has contributed more to the sobriety of the Chinese than the severest laws of that nation. The gout and stone are said to be unknown in China; and this has been attributed to the use of this plant.

Tea was scarcely known in Europe before the middle of the 17th century; but now more than 50,000 tons of shipping are employed in its importation. In 1664, 2 lbs. 2 oz. of it was brought by the East India Company to London for the king; and, in 1666 it was introduced into Europe by the Dutch East India Company and sold for $13 per pound. In 1800 the consumption in Great Britain was 20 million lbs. which is about the quantity now annually consumed there. The average consumption by each person would then be about 1 lb. annually. In 1838 the importations into Great Britain were 32,366,412, and in 1840, 40,413,714 lbs. The average quantity consumed in Ireland is only about half a pound by each person annually. In the United States about 8 millions, in Holland about 3 millions, in Russia 6 or 7 millions and in France 2 millions. The consumption in France has long declined, and coffee has been substituted, though it is said to be reviving. The consumption in the United States does not increase with the population. The average annual imports for six years prior to 1840 was 14,500,000 lbs. The value of the imported teas into this country in 1840 was $5,417,589.

T. Bohea; flowers white, with 6 petals; stem bushy; branches numerous, leafy; leaves alternate, evergreen, eliptical, oblong, cerrated; anthers and stigma yellow; resembles the Camellia. E. I.



COFFEE TREE, *Coffeea.*—C. 5, O. 1, Rubiacea, sp. 2-28, Et. & Es. 6-20 ft.—so called from the Arabic name of the liquor obtained from the berry, or *Caffa* from a province of Africa. C. Arabica is an erect low tree with white flowers resembling those of the Jasmine and of a grateful odor. The berries are of a greenish red when grown, and dark when ripe, with two lobes and two seeds, each of the size of a pea. A decoction of these berries forms the well-known drink *Coffee*, which is said to have been in use in Ethiopia from a very early period.

The introduction of coffee was first into Arabia from Persia about the middle of the 15th century. Its use there as a drink is ascribed to the prior of a monastery who, on being informed that his cattle, browzing on this tree, would sometimes wake and caper during the night, concluded to test its virtues on his monks to prevent their sleeping at matins. Others prove its introduction from Persia by a Mufti, of Aden, at the mouth of the Red Sea, who finding that it dissipated fumes of the head, inspired joy, prevented sleep, &c., recommend its use to his dervices with whom he spent the night in prayer. This ultimately introduced its use, though prohibited by the Syrian government. There is a manuscript in Paris, written by a Sheikh, which proves that coffee was introduced by a Sheikh and scholar, *Dhabani*, of Arabia Felix, about 870. In Egypt is use was regarded as a religious ceremony. Coffee passed to Mecca, then to Arabia Felix and Cairo, and from thence to Syria and Constantinople in 1554. It was introduced into Venice

about 1616, Marseilles in 1644, Paris in 1657, and from thence into London. It is said to have come to London in 1652, and afterwards made for sale by a Greek and by an Armenian from Paris.

Coffee soon came to this country, on its settlement by Europeans. It is said that all the coffee trees cultivated here and in Europe are the progeny of a single plant presented in 1714 by the magistrates of Amsterdam to Louis 14, king of France. This being placed under the care of the celebrated Jussieu, whose name we have often mentioned in this work, it was in a few years widely distributed. Its use was strenuously opposed by the ministers of religion, even in Turkey, and by their influence severely taxed, but it is there used now to great excess; so that not to supply a wife with coffee has been deemed by the government ample reason for a divorce.

The tree was introduced into Europe by the Dutch, and also into Batavia, for cultivation, in 1690, then into Surinam in 1718, and by the French into Cayenne and Mauritius soon afterwards, and then into Martinique, and afterwards to other W. India Islands and Jamaica in 1730.

The mode of raising the plant is from seeds planted in nurseries and then transplanted into fields in rows and from 5 to 10 feet apart, chiefly on hills and sides of mountains, in fresh soil. In gravel it attains a height of only 6 feet. They produce fruit the following year and are in full bearing the third year. The produce of a good tree is from 1½ to 2 lbs. The berries are gathered by shaking them into blankets when they begin to fall, and their pulpy bark shrivels; then spread and dried, placed under sheds and passed between rollers to seperate the husks, then sifted, winnowed and bagged. The berries of the Arabian plant are much smaller than those of the West Indies and the United States, the increased size in richer soils and more humid climates being however at the expense of the flavor. The berries are sown soon after gathering them, as in 6 weeks they lose their vital powers. The plant may be raised from cuttings. There are 10 or more varieties described by botanists; some are peculiar to the East and West Indies South America, Arabia, &c. The *coffea Arabiaca* or *Jasminum Aribicum* is the tree affording most of the coffee of European commerce, of which there are two varieties. It is an Arabic evergreen 10 or 15 feet high, of a beautiful appearance at all seasons. The eastern coffee tree is about 15 feet high and 12 feet in Europe. The berry is as hard as horn and is 4 or 5 inches long and 2 broad. Coffee cannot be cultivated in a climate falling below 55°. The worst West India or American coffee, it is said, if kept a few years, not over 10 or 14, becomes as good in every respect as that from Turkey.

The period of flowering does not last longer than 1 or 2 days. The blossoms expand so profusely in one night as to give to a plantation the appearance of a sudden fall of snow. In the East the berries are sha-

ken upon a blanket and spread out to dry in the sun, then rolled, and again dried. The berries are pressed into bags by the negroes in the West Indies, each averaging 3 bushels a day, and each bushel yielding 50 lbs. of merchantable coffee. Sometimes the coffee is exposed to the sun in layers 5 or 6 inches deep on a platform, when in a few days the pulp ferments and gives off an acidulous moisture, and in 3 weeks the husks are seperated in a mill with fluted rollers and the berries are winnowed.

The preparation of coffee.—The Mahommedans make their coffee from the pods as well as the berries, and some say that these are the flower of the coffee tree, but they are not so easily transported. The preparation commonly consists in roasting the berry in a metalic vessel or cylinder till thoroughly brown, and the grinding as much as is required for the occasion; as its flavor is soon lost by exposure when burned, and especially when ground. The Turks do not sweeten it by sugar, but add to each dish a drop of the essence of amber, or boil it with 2 or 3 cloves, &c. It is one of the *necessaries*, it is said, with which they are obliged to furnish their wives.

When roasted in any quantity, it is common here and in Europe to use an iron cylinder full of holes and turned by a crank over a charcoal fire, now and then taking it up and shaking it. When the oil rises the berry looks bright and oily, and it is of a dark brown; it is then emptied into receivers and shaken till cold. The smell of the oily matter distinguishes it from peas or beans, barley or rye, which are much substituted by coffee grinders. Care should be used that it is not burned.

The *Mocha* coffee is small and of a dark yellow; the *Java* and *East India* coffee are larger and of a paler yellow, and the W. India, Ceylon and Brazil is of a blueish or greenish grey. The outer pulp and the inner membrane investing the seeds are used by Arabians; *the former constitutes the coffee a la Sultane.* If stowed in ships with rum, pepper, &c., it is said to acquire a bad flavor, and hence the inferiority of much imported coffee.

The qualities of coffee are known as those of the *Mocha* coffee, which is the best; the next best is Java coffee from the Red Sea, and the cheaper kinds are from the West Indies and Brazil. If underdone its qualities will not be imparted, and its use will oppress the stomach, and if overdone it yields a flat, burnt and bitter taste; its virtues are then destroyed; it is heating to the body and acts as an astringent. In Asia, and sometimes elsewhere, the coffee is pounded and each cup is boiled by itself. The Turks do not separate the coffee from the infusion, but leave it in the dish. Coffee is best when made in the form of an infusion. In that of a decoction and boiled, as it is commonly prepared, the fine aromatic oil, producing the flavor and strength, is dispelled by the boiling, and a mucilage is extracted which renders it

weak and insipid. Boiling water should be poured through the coffee in a strainer, or poured upon it and left to stand on the fire not over ten minutes. The best coffee is made in France and Turkey, and the poorest in England and the United States. Ground coffee, as commonly sold in shops in our large cities, is much adulterated and has few of the properties of the best article.

It is adulterated, especially in England, with chicory. This is detected by shaking the coffee in a glass, when the pure coffee swims without coloring the water, while the chicory sinks and colors the water red. Roasted grains of any kind are detected by the blue color produced on the addition of a solution of iodine to the coffee in cold water. The aroma of coffee is said to be caused by the decomposition of an acid (*caffeic acid.*) A volatile neutral, called *caffein*, exists in coffee. The other constituents are *gum, resin, fixed oil, albumen, extractive and lignin.* The principle peculiar to coffee forms 17.59 per cent. of *raw* and 12.50 of *roasted coffee.* Raw coffee has been used medicinally like Peruvian bark; it is slightly nutritive, but when ground this property is destroyed and an impyreumatic matter is given out which is stimulating to the nerves.

The properties of coffee are known to be a powerful stimulant and cordial. Coffee is used as an antidote to the effects of narcotics and to relieve those of intoxicating drinks. It is good when strong for asthma, for exhaustion from fatigue, for sickness at the stomach, headache, &c. It has been used as a febrifuge in intermittents, as a stomachic in dispepsia, and an astringent in diarrhœa; but some of these virtues are disputed. Its use is to be avoided by those having affections of the heart. It is said to be an enemy to the skin, depriving it of freshness, softness, &c. Those nursing should use it sparingly.

Many sermons were preached against coffee when it was introduced into Europe, one of which has the following: "They cannot wait until the smoke of the infernal regions surround them, but encompass themselves with smoke of their own accord, and drink a poison which God made black that it might bear the devil's color."

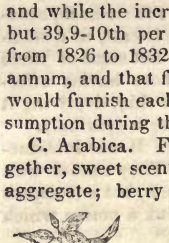
The amount of exports in 1831 from the different places where it is grown was 123,500 tons, or 251,000,000 lbs., nearly a fourth part of which was consumed in Great Britain and America. Of the 147,000 tons estimated by McCulloch as produced, 42,000 tons were from Spanish Main, 25,000 from Cuba and Porto Rico, and 20,000 from Hayti. The consumption estimated by him was, G. Britain 10,000 tons, Netherlands and Holland 40,500, Germany and around the Baltic 32,000, France, Spain, Italy, Turkey, &c., 35,000, and America 20,500—total, 138,500 tons. The average annual importation into France from 1830 to 1832 was 11,476 tons, or not three-fourths of a pound for each of her population. In Great Britain, at 22,000,000 for 1830, it was also less than a pound each. But in 1840 she imported 39,932,279 pounds.

Arabia supplies about 15 million lbs., and St. Domingo, before the revolution, exported 70 million lbs. annually. France probably now consumes more than any other European nation.

The consumption in the United States from 1821 up to 1831 was nearly trebled. The value of imported coffee in 1840 was $8,546,222 and the amount continues to increase. From 1821, when the quantity was 21,273,659 lbs. the increase up to 1831 is shown by the imports of the latter year which were 81,757,386 lbs. In 1835 the amount was 103,199,577 lbs. costing $10,715,466. It was less up to 1839 when it rose to 106,696,992 lbs. and in 1840 it was 94,996,095 lbs.

But we have constantly exported large amounts. In 1821 the exports were 9,337,596 lbs.; but averaging up to 1835 about one-third the amount imported; since which the exports have greatly decreased; and, since 1837 they have been comparatively very small. The imports from 1826 to 1832, both inclusive, were 418,667,681 lbs. and from 1834 to 1840, 655,116,660, showing an increase during the last 7 years of 236,448,979 lbs. And there was a decrease in the amount of exportations during the last period of 45,553,586 lbs. which added to the increased importations makes the increased consumption during the last 7 years over the first 7 of 282,002,565 lbs. The amount consumed, therefore, since 1833 has increased in the U. States over 101 per cent., while the price has increased both here and where the article is grown, and while the increase in the population from 1830 to 1840 has been but 39,9-10th per cent. The average consumption of each person from 1826 to 1832, according to the census of 1830, was 37-10 lbs. per annum, and that from 1834 to 1840, taking the population of 1840, would furnish each person 47-10 lbs. This shows an increased consumption during the latter period of 1 lb. annually by each person.

C. Arabica. Flowers 5 cleft, white, sessile, axillary, 4 or 5 together, sweet scented; leaves oblong, accuminate; peduncles axillary, aggregate; berry dark red, oval, globular. Arab.



CHOCOLATE NUT TREE, *Theobroma cacao* C. 18, O. 1. Malvaceæ. DT. 2 sp. 16 ft.—from *god* and *food*. The tree is beautiful; it is 5 or 6 inches in diameter, and resembles the cherry or apple tree, producing a smooth nut of the size of an almond, in a pod having from 20 to 100. These oily seeds are dried or roasted, ground to a powder, made into a paste with sugar and water, or orange-water and aromatic spices, then formed into cakes, exported and extensively used as a wholesome beverage. The covering of the nuts are the *shells*, also much used. The cacao harvest is quite uncertain, but one person is capable of taking care of 1000 trees, which yield annually on an average, about 18 bushels of the kernels. The tree is common to S. America and West Indies, and was cultivated under Monte-

zuma, when the seeds were used as money, as they now are. Some 6 or 8 are of the value of a penny. The trees are raised from seeds and do not bear under 6 years. Some Mexicans raise 5000 lbs. of cacao seeds annually in their gardens.

The flavoring ingredients are commonly vanilla, cloves and cinnamon, and sometimes annotto, musk, annise and ambergris. An analysis of the kernel gives 53 per cent. of fat or oil, 17 brown albumenous matter, which contains the aroma of the kernel, 11 starch and 8 of gum or mucilage. The husks afford 12 per cent. by weight of the kernel, but they have no fat or oil, being mostly mucilage and lignin. There are two principal crops annually. The Indians make a kind of bread of it; thus making it food and drink. When fresh and pulpy, the kernels may be eaten like other fruit; but when dry they are exported in bags. When ground and made into paste, it is formed into cakes in hot tin moulds, and this is afterwards the chocolate of the shops. If kept free from the air, it may be preserved for some time, though not over two years. It is always best when new and is very agreeable and nutritive to healthy persons. It would be less objectionable, however, if the vanilla and some other flavors were omitted. But much of the chocolate sold at the shops has little of the properties of the genuine article. It is made to *froth* by the addition of soap. It is the opinion that much of it is made with half cacao and the remainder of flour and Castile soap, especially in England and the United States. In Mexico and Spain, where the article is genuine, it is almost indispensable at breakfast and is considered an object of prime necessity. It is also greatly esteemed in France. The chocolate of Caraccas is considered the best.

A white oily matter is obtained from the seed by bruising and boiling them. The oil rises to the surface where it congeals. This is called the *butter of cacao* and, when fresh it has a very mild taste, and is used in pomatums. An oil is also obtained from the nuts or shells, sometimes used in medicine. The best chocolate dissolves entirely when heated, even in the sun and without water.

The thin *shell* of the cacao nut is ground like coffee and boiled, yielding a beverage resembling that made of the kernel. It is economical and wholesome, but less rich than the oleous compound. The shells are extensively imported into Europe and this country. In 1806 the consumption of cacao in Europe was estimated at 23 million lbs., of which from six to eight millions were consumed in Spain. The amount thus imported of husks and shells by G. Britain in 1840 was 384,842 lbs. and of cacao 4,096,409 lbs. The value of cacao imported into the U. States in 1840 was $161,389 and the amount of chocolate manufactured here was $79,500.

T. Cacao—*Smooth-leafed chocolate tree*—leaves entire, alternate,

stalked, drooping, one foot long, elliptical, pointed; flowers reddish, small, in tufts; calyx rose colored; fruit red or yellow. S. A.



SUGAR CANE, *Saccharum officiniarum* C. 3, O. 2. Graminæ. sp. 1-14, Ds. 6-12 ft.—from the Arabic *Soukar*. This grass or reed is not only one of the most important of that great natural family, but one of the most valuable vegetables known to man. The species are found wild and cultivated, and are natives of the East and West Indies and America, growing on the banks of rivers, meadows, &c. It is found abounding in the U. States, South America, the Indies, China, Africa and South Sea Islands, and is now greatly cultivated in a zone ranging from 35 to 40° on each side of the equator. It was probably first cultivated for its juice in China and the E. Indies, as the Venitians imported it from thence in 1148. It was afterwards cultivated in Sicily, Crete, Rhodes and Cyprus, and an abundance of sugar was made there prior to the discovery of America in 1492. It was brought by the Moors from Egypt. The Arabs obtained it from China, and are said to have known how to make it for 800 years. The sugar cane has been cultivated in China from immemorial time, certainly 2000 years before it was known in Europe. Previous to 1416 however it was known only as a medicine in Europe, from all we can learn. It was afterwards cultivated in Spain; and in the 15th century it was introduced into the Canary Islands, thence into Madeira, and thence to the Brazils, and afterwards to the W. India Islands. The Dutch commenced making sugar in St. Thomas in 1610, and the English in Barbadoes in 1643, and it was first cultivated in the United States in 1700.

There are now several varieties cultivated on this continent which are said to have been brought here from Bourbon, Java, &c., all of which have been greatly improved. The old Brazil cane has been entirely superceded by a larger variety ripening several weeks sooner. The sugar cane is very luxuriant in our southern states and often attains a height of 20 feet; but in arid and calcarious soils it does not rise above 6 or 8 feet. It flowers, but does not ripen the seed in this country. Humboldt maintained that the sugar cane is indigenous to America. The varieties here are the *African*, *Otaheitan*, *West Indian* and *Riband*, the last ripening several weeks earliest. The cane is raised chiefly on the gulf coast and bayous.

Sugar.

This is undoubtedly one of the most valuable vegetable substances

known in civilized society; and, from the great variety of its uses in life, ranks inferior only to the cereal grains we have just described. It now forms one of the first articles of commerce throughout the world, and is one in which our own country is greatly interested by its production. It is considered by political economists as a test of the relative degrees of comfort and civilization enjoyed by a people, though it has done more, perhaps, towards establishing slavery by the British than any thing else.

Sugar is described by Pliny and Galen as a "sweet salt," and was apparently known to them only in medicine. Strabo says, "reeds in India yield honey without bees," and others of that time thought it was found adhering to the reed, or exuded from it; but sugar, as they knew it, was probably sugar candy from China. It was first substituted for honey in medicinal compositions by Acturias in the 10th century, and was then called "*Indian salt*," it was kept and used in the mouth during fevers, etc. Much has been written against this as well as most important vegetable substances, fortunately with no better success; many have also advocated the great advantages of its use. But modern chemistry has established its just relative merits.

For the two last centuries it has been an important ingredient in the popular diet of the people of Europe and America; and its consumption has constantly and rapidly increased in all civilized parts of the world. If the ancients knew how to express the juice from the cane they certainly had no knowledge of the art of condensing and clarifying it, if we except the Chinese.

Sugar as a constituent of vegetables has a wide range and is contained by them either ready formed or so combined as to be developed in all that yield alcohol. From many of these it has been obtained in various ways. The chief of these are the sugar cane, the beet, the maple tree, Indian corn and parsnip. The manufacture of sugar in this country from the second and third sources will be described separately, and that from maize is noticed under the head of that grain. All liquors in order to undergo the vinous fermentation must contain sugar. The farina or starch of the seeds of all plants is converted into sugar by germination; but the seeds, as with the cerealia, have no saccharine taste in a dormant state.

The cultivation of the sugar cane is always by cuttings, as the seeds are not known to vegetate here. There are three varieties cultivated, the *white*, *red* and *elphantine*. The top joints are taken for planting, having less saccharine matter than lower parts, yet as much vegetative power. The ground is generally moist, and the cane is planted in rows three or four feet apart and in holes 8 or 10 inches deep, with intervals of two feet between them, and often with still wider spaces for carting. It comes to perfection in from ten to fourteen months. It was formerly hoed by hand labor, but lately by the plough, when the

soil admits. It is not planted annually, but the roots of a part being left, fresh canes (*rattoons*) spring up as large the first year as planted canes. But these deteriorate annually; and the removal of the plants is therefore resorted to once in a few years, or in spots where they are thin. Sometimes, by careful culture, the roots have afforded good rattoons for 20 years. A plantation lasts from six to ten years. In India great care is taken in the cultivation; but scientific skill fails there to produce as good sugar as here. They suffer no innovation on old practices. If at a trifling expense, the improvements of machinery were introduced, India might supply all the markets of Europe with sugar.

The manufacture of sugar in this country, where art is probably most perfect, requires much labor and skill. The processes are too long for details in this place, we thererore give only outlines.

The reeds, when ripe, are cut off at a joint near the roots, and lie a few days to ferment; the leaves are cleared and the stems tied in bundles and conveyed by mules to the mill. This consists of three iron fluted cylinders placed horizontally or perpendicularly, closely matched, through which the reeds are passed twice, in order to express all their juice. This runs into a cistern and is drained from thence into the *boiler* and immediately submitted to heat, with the addition of lime which imbibes the acid; it otherwise becomes acid in a few minutes. The lime assists the separation of the feculent matter in the juice, and the heat is just sufficient to cause the impurities to collect on the surface to be skimmed off. It is then conveyed into other boilers and a rapid boiling is produced, to evaporate the water and reduce the juice to a consistency for granulation on cooling. It is then transferred to a wooden cooler or shallow trays where a part concretes into a crystalized mass and the molasses is conducted off. It is then put into hogsheads with the lower head perforated with holes, and placed over a cistern, so that the molasses may run through. The casks are then filled up with sugar and exported, under the name of *muscovado*, or *raw* sugar.

This is the state in which it is exported, but it is often ground over by grocers and better fitted for sale. On some plantations the sugar is submitted to another process called *claying*, which is to place it, when cool in funnel-shaped moulds, as done in our sugar refineries, with the small end downwards and the upper one covered with wet clay, the water of which soaks through the sugar and removes any remaining molasses. This is then called *clayed sugar*, and is commonly divided, when taken from the mould, into three parts, the upper parts being relatively the whitest and best.

The quantity of juice obtained in some mills is 10,000 gals. per day; but this and the amount of sugar varies with the season, soil, quality of cane, &c. Commonly every five gals. of juice yield five or six lbs.

of crystalized sugar and is afforded by 100 full grown reeds. The fuel used in boiling is supplied by the dried cane itself after the juice is expressed. The molasses thus drained off, and the uncrystalizable portion of the juice, is exported for domestic use, or with the skimmings, &c. is fermented and distilled into rum. In favorable seasons the treacle forms, proportionably, a small part. The amount of spirit produced from this is five or six gals. for every 100 weight of sugar.

The refining of sugar is usually another process, performed after exportation. It is boiled in pans with lime water and a portion of bullock's blood, or hydrate of alumina. The albumen of the blood mixes with the impurities of the sugar and rises to the surface, where it is skimmed off; the white of eggs and butter are said sometimes to be added. When purified in this way, it is placed in coolers and agitated till it becomes thick, or strained through woollen bags, or is made to pass through animal charcoal. It is then placed in conical iron or unglazed earthen vessels, the large end uppermost, when the remaining uncrystalized syrup runs off through the small hole in the apex. Wet pipe clay is then covered over the top an inch thick, the water of which drains through the sugar, carrying off the remaining coloring matter, and this is repeated. It is then carefully dried, and constitutes *Loaf sugar*. It is *refined* or *double refined* according to the number of operations. The green syrup which passes from the mould is made into *lump sugar*. The art of clarifying or making loaf sugar was the discovery of a Venitian about the first of the 16th century.

63 million lbs. of raw sugar were refined in the 43 refineries of the United States in 1840. Almost all the sugar imported from beyond the Cape of Good Hope is refined here. $1,260,000 is paid annually to operatives in this business. The price at which refined sugar is afforded the consumer here is from 10 to 13 cents per lb.; in England it is from 17 to 23 cents, and in France from 17 to 20 cents. From 100 lbs. of raw sugar (one-third white Havanna and two-thirds brown) the product of refined is 51½ lbs.

Candied sugar is made by dissolving common sugar, slowly evaporating the water, and re-crystalizing it; and it is brown or white, according to the sugar used. This is the only sugar esteemed in the East. White sugar candy is the raw sugar boiled and clarified in moulds, as before described; it is made to crystalize in various ways. Besides the numerous uses and delicate preparations made of this, it is used by miniature painters to prevent colors from cracking when mixed with gum-Arabic. It is much used with wheat flour to make sugar toys, &c. The value of confectionary made in the United States in 1840, was $1,148,565 and the capital in the manufacture was $1,769,871, chiefly in Mass. La. Penn. N. Y. and Md.

Most modern preparations of sugar, much extolled for their medicinal virtues in curing diseased states of the bronchæ and other thoracic

viscera are sheer quackery. Sugar is much boiled in barley water in England, and hence called *barley sugar*. Other candies are similarly prepared. The mode is to boil till brittle, cast it on a stone anointed with oil of almonds and then twist it into sticks; saffron, oils and essences, &c. are added, to suit the taste, and herbs, frequently, for colds, hoarseness, &c.

Syrup is a solution of sugar in water, and is often flavored with vegetable substances, and hence the many varieties of the shops. It is formed by dissolving sugar in ¼ its weight of water. It keeps well in close vessels, but if considerably diluted, it changes rapidly, if exposed to air, and becomes sour and mouldy.

Molasses is much used in this country for various domestic purposes, for making *brown candy* and for the manufacture of spirits. The latter use, however, has greatly diminished, most happily, within a few years; for the liquor commonly made of it is vile stuff; and, *flavored* with the pernicious drugs known to be used, it is destructive and abominable. Molasses, by the addition of yeast, undergoes the acetic and vinous fermentations. Some of the molasses is converted into coarse soft sugar called *bastard*. It is used in large quantities here and in Europe, by bakers and in confections, in the preparation of tobacco, in preparing preserves, &c. A large amount is imported from the West Indies into the United States for these purposes. $2,910,791 worth was imported in 1840 and Great Britain imported 650,055 cwt.

The qualities of sugar are widely known. It preserves both animal and vegetable substances from putrefaction and is a principal ingredient in the preparations of all vegetable food. It is nutritious in moderate quantities, but is not apt to agree with the weak and dispeptic. With other approximate nutritive principles, it increases their value as food. Its effect on the negroes is remarkable. The children and even the cattle and dogs on the plantations grow fat during the sugar season. Animals fed on sugar alone, however, soon manifest feebleness and disease. The fondness of children for sugar is doubtless instinctive, as the milk on which they subsist when young is composed in part of it. Its effect on the teeth of children are mostly ideal and generally a device of economical mothers. No people in the world have finer teeth than the negroes, much fed with it on sugar plantations. It is a mild vermifuge and is of the greatest advantage in most medicinal prescriptions, in beverages, and liquors of most kinds.

Sugar is the important element in vinous and panary fermentations and is an active agent in most chemical changes in vegetable organic bodies. It is composed of *water, sugar, gum, green fecula, extractive, gluten, acetic and malic acids, acetates of lime and potash, super-malate and sulphate of lime and lignia.* The common sugar contains a portion of lime, tannic acids, glutinous and gummy substances, &c.; but the process of *refining* removes these. One cwt. of raw sugar, af-

ter refining, is said to consist of refined sugar, 89 lbs. bastard do 17 lbs. molasses 16 lbs. of which 12 lbs. are solid matter, and water 4 lbs. Sugar is called a neutral salt; it gives a gloss to ink, varnishes and pigments. When very cheap it has been used to fatten cattle.

The composition of pure sugar (candy) is 42.85 carbon and 57.15 water; when less pure it contains less carbon and more water. Maple and beet sugars contain 42-1 carbon and 57.9 water. The saccharine principles are *sugar, gum, vegetable jelly, starch and lignin,* all of which consist of carbon and oxygen and hydrogen, generally in the ratio to form water. Of these 5 principles, sugar alone is crystalizable and therefore is most removed from organized life. These are the common sugars of the cane, maple and beet and the *granular sugars* of the grape, honey, starch and diabetic sugars and the sugar of milk; the *uncrystalizable*—liquid or mucous sugars, are molasses, &c. In a healthy stomach sugar is readily digested and is nutritious. It contributes directly to the nutrition of plants and especially the young. It is a constituent of milk, but birds, dogs and fowls die when fed alone on it. The copious use of it is to be avoided.

The character of sugar is distinguished, when pure, as a white granular solid, but crystalizable in 4 or 6 sided prisms, terminated by 2 or 3 sided summits and the crystals are nearly anhydrous. The specific gravity is 1.4 to 1.6. It is hardly soluble in alcohol, though proof spirits dissolves it in considerable quantity. Sugar combines with the oxide of lead forming *saccharate of lead,* and also other oxides. It has little or no action on salts. With water it reduces muriate of gold and other metalic salts. From the average of experiments its composition is 50.50 oxygen, 42.50 carbon, and 6.80 hydrogen. 45 lbs of sugar during fermentation are resolved into 23 alcohol and 22 carbonic acid. Sugar and water do not ferment alone.

Sugar has been extracted from elm dust and several of the woods, and of late from woolen rags by means of sulphuric acid, with chalk. A pound of rags are thus convertible into more than a pound of sugar. The process of manufacturing sugar from old rags is now considerably carried on, it is said, in parts of Germany.

Sugar in the United States is a subject of increasing interest. The demand is rapidly advancing. Its production in the state of Louisiana, to which it is here principally confined, is a scurce of much wealth. The capital employed in that state is $52,000,000, with 40,000 hands and 10,000 horses, and the average annual manufacture of sugar more than 80,000,000 lbs., and 4,000,000 gallons of molasses. The cane crop in the U. S. last year (1842), was an average one, and the whole aggregate sugar crop of the year was 142,445,199 lbs., though near 13,000,000 less than in 1840. Our imports in 1840, were of brown sugar, to the value of $4,742,492; white or clayed, $838,458. But there was exported of refined sugar to the value of $1,214,658. It is

thought a supply of sugar for home consumption might be produced in the U. S. The consumption in the U. S. in 1830 was about 70,000 tons.

The product of a hand on a sugar estate is put down at the cultivation of 5 acres, producing 5,000 lbs. of sugar, and 125 gallons of molasses. The value of the sugar on the spot is 5½ cents a pound, and the molasses 18 cents a gallon; total, $297.50. The annual expense per hand, tools, &c., $105. Two crops are made in succession on the same land, one of plant-cane, and one of rattoons; it then lies fallow two years, or is planted with Indian corn or peas. An acre yields about 12,00 lbs. of sugar. The state of Louisiana has 700 plantations, 525 in operation, producing annually about 90,000 hogsheads of 1000 lbs. each. The raw sugar imported in 1840 was, 121,000,000 lbs. valued abroad at $5,600,000, and imported from 6 different countries. This, with our own product, is over 263,445,000 lbs. But maple sugar constitutes in addition a large proportion of our domestic consumption, amounting annually to 8 or 10 millions lbs. The protection afforded by a tariff has greatly increased the production of sugar in the U. S. From 1816 to 1828 this increase was from 15,000 to 45,000 hogsheads.

The annual consumption of sugar in Great Britain in 1830 McCulloch estimated at 180,000 tons, or over 400,000,000 lbs., which was about 30 lbs. for each person. The consumption is rapidly increasing there and on the continent, where the annual consumption is 260,000 tons. The British West India Islands yield about 195,000 tons. Other West India Islands, 200,000, and Brazil, 75,000. During the first half of the last century the consumption increased *five-fold*. The sum total of sugars brought into all the markets has been estimated for 1838 at 738,000 tons, but the present average quantity produced of all kinds may be estimated, in round numbers, at one million of tons. Great Britain employs, according to an English account, 200,000 tons of shipping in the exportation of 500,000,000 of lbs. of sugar from her colonies, which, if consumed by her twenty-eight millions of people, would be equal to 25 lbs. each; but this is so taxed that the poor can get but a fraction of this proportion, as the revenue from this is annually $22,200,000. The British imported, in 1831, from their East India possessions, 485,326 cwt., costing from 22 to 35s. with a duty of 24s. Notwithstanding the large amount imported, Mr. Huskisson has said that "two-thirds of the poorer people drink their coffee without sugar."

The average annual amount consumed by each person is, in Ireland 5 lbs., in France 7, Spain 7½, United States 18, and England 23. The consumption of maple sugar and molasses in the U. S. makes the amount equal, probably, to 23 or 24 lbs. each!

S. Officinarum; leaves flat; flowers in pairs, panicled, on loose zigzag spikes; panicle spreading in feathered branches, 1 foot long; stem 10 feet, jointed.—E. I. and A.



COTTON TREE, gossypium herbaceum, C. 16, O. 7. Linn. Columniferæ, Juss. Malvaceæ, sp. 6-10 A. 3 ft. This important plant was evidently well known to the ancients, but its use in the manufacture of cloth, for which it is now so deservedly celebrated, has been generally known only during the last century. The Hindoos were the earliest manufacturers of cloth from cotton. Herodotus says "there is a tree in India producing a kind of wool superior to that of sheep, and the natives dress themselves in cloth made of it."

The cotton plant has bright green 5 lobed leaves. The flowers are a pale yellow and 1 petaled. The pods are triangular, 3 celled, and, when ripe, they burst open, displaying their beautiful snow white contents, within which are *black* seeds of the shape of grapes. The fibres of the down are very fine and flexible, and the threads are finely toothed, which causes them to adhere closely together, and to make good thread. The shrub is about the size of the currant bush; and, though an annual, yet by repeated cropping it may bear sufficiently for 3 years. The seeds are sown in rows 6 or 8 feet apart. In 5 months the plant flowers, and in 7 the pods form. When ripe, it is picked by hand, gined and pressed into bales, averaging about 300 lbs. each.

The down, or cotton wool, lines the capsule containing the seeds of the plant. Two species are cultivated, G. *herbaceum* and G. *barbadense;* the first is generally cultivated in the east and here, though the latter is said by some to be the species cultivated in the West Indies and America. There are numerous varieties growing naturally in the tropical regions of Asia, Africa and America and further north in the United States, where it is most abundant. In Europe, the Levant, Malta, Sicily and Naples are the chief places of its growth.

Several species are grown in the E. Indies, but principally that first named, which there produces a down of a nankeen color. The seeds of all the species yield oil, and this is eaten in the Levant where it is considered very wholesome. Cotton is distinguished in commerce by the color, length, strength, and firmness of its fibres. White is the common color, but the yellow, if not the effect of accident, is indicative of greater firmness. The varieties in the market are characterized by the places where they are produced. They are generally known as *long* and *short stapled.* The *sea-island* is the best of the first and is grown mostly on the shores and islands of Georgia. The

price, however varies greatly, from differences in quality. Superior Brazil cotton is among the long-stapled. The best of the *upland cotton* is grown also in Georgia. The Cottons of India are short stapled and these, until lately, have been wholly consumed there.

Cotton in the U. S. has increased beyond a parallel in the history of any vegetable product. The first plant was cultivated in 1787, though it is indigenous. In 1791 there was grown in the U. S. 2,000,000 lbs., half in each of the states of S. Carolina and Georgia. In 1801, 40,000,000 lbs. were raised, part being grown in some other states. In 1811, the crop was 80,000,000; in 1821 it was 170,000,000; in 1828 it was 348½ millions; in 1833 it was 437¾ millions; and in 1840 790,479,279 lbs. S. Carolina yielded the most cotton from 1791 to 1826; then Georgia to 1834, then Alabama and Mississippi, and now the latter is the most productive state.

The cotton of the southern states is of 3 kinds, the *nankeen*, the *green seed* (white with green seeds) and the *black seed*. The two first or *short stapled*, grow in the upper or middle country and the last in the lower country, near the sea and on small islands. This long stapled is fine, white and strong. The *roller-gin* and *saw-gin* are the machines used for cleansing cotton: The first consists of 2 rollers, between which the cotton passes; the size of the seeds prevent them from passing through. The latter was invented by Mr. Whitney in 1793 and consists in a receiver having one side covered with strong parallel wires ¼ of an inch apart. Between these pass circular saws, and the cotton becomes entangled in the teeth of these and is drawn out through the wire grating, which prevents the seeds from passing. The cotton is then swept from the saws by a revolving brush, the seeds falling out at the bottom. The application of this machine was a new era in the production of cotton in the U. S. Prior to this, little or none was exported, and not a pound in 1790. The rapid increase since is seen above.

The Exports from the U. S. in 1829 was, to Great Britain 498,001 bales, to France 184,821, and other parts of Europe 66,178—total, 749,000. In 1841 the amount exported to Great Britain was 902,191 bales; and she received from India the same year 274,984 bales, 50,000 lbs. more than in 1840, and 80,000 more than in 1839, or nearly equal to the consumption of the U. S. in 1840. The value of our exports of cotton in 1840 was $63,870,307.

The crop of last year was large, while that of 1840 was not an average one; that of 1839 was unusually large. The price has decreased, but improved modes of culture have lately been introduced. A planter of Alabama has raised from 3000 to 5000 lbs. per acre, where, by the old system, but 500 lbs. only were raised, and the quality of the article is said to be much improved. He says he has picked 5,989 lbs. from an acre. Texas is now beginning to raise large quantities of cotton, and

the French are cultivating it much more extensively than formerly. In Egypt, too, it is slowly increasing, and in India, as we have seen, the increase is rapid. It is certain, however, that no country can raise better cotton than that produced in the United States.

In India great attention is now paid to the cultivation of cotton, especially in the British possessions. Within a few years, several experienced cultivators in the U. S. have been engaged by the British authorities, who, with cotton gins and seeds procured in this country, are now employed in India for the purpose of raising and cleaning cotton. The success of the enterprise, though reported to have partially failed, is apparent in the rapidly increasing quantities raised and exported. The crop of 1841 exceeded that of the previous year by 38,538,303 lbs., or 105,874 screwed bales. The imports of cotton into Bombay amounted to 174,212,755 lbs., which is a larger quantity than that raised in the U. S. in 1826. For the two years 1840–1 the produce was nearly one third that of the U. S., and for the 3 years previous to 1840, it averaged about half that of 1841.

The annual growth of cotton in the U. S. and elsewhere now amounts to 1200,000,000 lbs.; 700 millions in the U. S., 30 in Brazil, 8 in the W. Indies, 27 in Egypt, 36 in the west of Africa, 290 in the west of Asia, and India, 35 in Mexico and S. America, (Brazil excepted,) and 80 in other parts. This at 10 cents is $120,000,000, but the average price for fifty years was about 19½ cts., which would make the present crops worth $234 millions.

The annual consumption of cotton is supposed to be 350 million lbs. in G. Britain; 130 millions in the U. S.; 80 do. in France; 250 in China and India; 25 in S. America; 35 in Germany; 45 in Turkey and Africa; 10 in Spain and 20 in Prussia. The value of manufactured cotton in G. Britain is annually about $170 millions, in France $70 millions and in the U. S. $50 millions. The capital employed in the manufacture in England is about $200 millions, in France 120 and in the U. S. $50 millions. The consumption in the manufacture in all Europe was in 1838, 500 million pounds.

The progress of cotton manufacture, has much interest, from the great rapidity which has marked that progress within the last half century. The immense capital invested in this business, with all the improvements which have been introduced, shows this branch of art to have no equal in the civilized world. It has, indeed, been the most extraordinary phenomenon in the history of industry. Even the fine fabrics of India and China are now rivalled in Europe, notwithstanding the great difference in the price of labor; and the raw material is taken from thence 5000 miles, manufactured and returned for consumption.

The manufacture began in England about the first of the last century, when the cotton was imported from India; but, up to 1773, only

a part of the cloth was of cotton; and the whole to 1760 was made in cottages by hand, when the value of the manufactures was 200,000 lbs. In 1767 the *spinning jenny* was invented by Hargraves. This was soon followed by the *spinning frame* by Arkwright; and on the expiration of his patent in 1785, the *mule jenny* by Crompton, and not long afterwards the *power loom* by Cartwright. These combined, soon brought the manufacture to great perfection; and the market for the fabrics made, was rapidly extended over the civilized world. The total annual average value of the manufacture of cotton in G. Britain has been £36,000,000 and the cotton imported has averaged 220,000,000 lbs.

The manufacture of cotton in America by machinery, was introduced in 1787; but it made little progress prior to the non-intercourse acts and the war of 1812, which gave a wonderful impulse to the genius and industry of our countrymen. This was however temporarily prostrated by the peace of 1815. But the protective duty of 1816 and the cotemporaneous introduction of the power loom gave increased activity to this branch of our industry; and, followed by the acts of 1824–28–32, multiplied the manufactures here more rapidly than during any period of their history in this or in any other country. In 1825 the consumption had reached 100,000 bales and in 1840, 300,000 bales, or 120 millions lbs. which was equal to the whole of our exportations of cotton up to 1820. The fabrics made were also distinguished over all others for their weight and strength, which soon gave them preference in the principal markets of the world and induced their imitation by English manufacturers. The inferiority of the latter, though stamped with *American* marks, has not however successfully competed with the American cloth. The result of this was to reduce the price per yard from 16 cts. in 1816 to 7½ cts. in 1840. Sail duck, negro cottons and drilling were wholly of American origin, and they are now those exclusively of American sale.

The difference in price of the raw material in England and America and also of water power with a superiority in parts of the machinery, enables our manufacturers, with a slight protection, to compete successfully with those of that country; and no where in the world are manufactories conducted upon so healthy and liberal a system as in this country. The finer descriptions of white goods have also lately equalled those of the foreign fabric, both in price and quality.

Calico Printing was introduced in 1825, and the progress of this branch of the art was even more rapid than that of the construction of the fabric; so that in 1840 it amounted to 158,058,000 yards, or 5,267,600 pieces, valued at $16,500,000, and employing a capital of $25,000,000. The beauty of the productions in both designs and colors now rivals, if they do not excel, those of England and France; yet, for four years prior to 1842, there were annually imported 21,852,-

610 yards of colored or printed cottons, costing $6,049,433 per annum. The importation of white cottons averaged for the above four years in value $1,415,893. But the value of manufactured cottons imported in 1840 was $6,504,484 per annum. This, with other facts illustrative of the singular *penchant* of our countrymen for things foreign is fatal alike to the arts and the independence of our country.

The *Manufactories* in the U. S. in 1840 were 1240; the number of spindles 2,284,631; printing establishments 37; and dying houses 92; persons employed 72,119; capital invested $51,102,359; and value of manufactures $46,350,458. Of this, the products of Massachusetts were $16,553,423; of Rhode Island $7,116,792; Pennsylvania, $5,013,007; and New York $3,640,237.

It is stated that nearly a million and a quarter of yards of cloth are made at Lowell, Mass., per week; employing about 9,000 operatives (6375 females) and using 434,000 lbs. of raw cotton per week. The annual amount of raw cotton used is 22,568,000 lbs., enough to load 50 ships of 350 tons each, and of cotton manufactured 70,275,910 yards —100 lbs. of cotton will produce 89 yards of cloth.

The Manufacture of Cotton in England, though now and heretofore far exceeding that of the U. S., will not, it is quite probable, maintain her superiority in the quantity, as she does not equal France, and, in some fabrics, the U. S., in the quality of articles manufactured, especially if consistency of legislation affords the required encouragement to this and other branches of our productive industry. Some idea, however, of the extent of the present manufactures of cotton in England may be gathered from the facts that the manufactures there now give employment to 1500,000 persons, and the value of the goods produced exceeds 31 million pounds. It has been calculated that the cotton yarn annually spun there would, in a single thread, encircle the globe 203,755 times, would reach from the earth to the sun, or encircle the earth's orbit 8½ times; and the wrought fabrics would girdle the circumference of the equator 11 times. It furnishes one half of British exports, and the receipts of merchants and manufacturers from this business, equal two-thirds of the revenue of the kingdom. One man now produces, by the aid of machinery, as much as 300 did at the beginning of the century, and the steam-engines now do the work of 33,000 horses; yet the operatives have increased from 40,000 in the reign of George III. to 1500,000. The amount paid for wages then was 220,000*l.* or 2s. a week; it is now but 63,000*l.* per annum. It seems that the number of persons employed has increased in the exact proportion that machinery has been improved, and that the rate of wages, on an average, has increased, while the cost of production has diminished.

It might seem from the extent of the manufactures of cotton, that the markets of the world are, or soon will be, overstocked; but cotton

is now made into the heaviest as well as the most delicate fabrics; and nothing seems so well calculated, from its strength, beauty, and cheapness, for universal use as cotton cloth.

G. Herbaceum; leaves 5-lobed, glaucous, pointed; stem smooth, bushy, branched, zigzag; flowers yellow or purple; capsule size of walnut in calyx like filbert.—E. I. & A.



HEMP, *Cannabis sativa*, C. 22, O. 5. Urticea sp. 1, A. Dh. 5-8 ft. This is an important plant, from the great use made of the fibrous parts of the stalk in the manufacture of cloth and ropes, especially *sail* cloth. It grows wild in the East Indies, but has long been naturalized and cultivated in Europe and this country. Russia is particularly distinguished for its growth and manufacture into canvass and cordage, whence most maritime nations import it in large quantities.

A moist, loose, or new soil, or black mould near water, is best for this plant. The seed is sown early in spring, and the stalk is pulled in four months. The male plant, or *fimble hemp*, matures and is pulled before the female, which is the *seed hemp*.

Hemp, when pulled, is tied in bundles and set up for 10 days to dry. These are then loosened at the top, and held upon a *Rundle*, and the seed beaten out with a flail, or otherwise, without bruising them. These seeds are valuable for their oil in painting and for burning, and also for birds and fowls, which are said thereby to lay more eggs, though some are said to change their plumage by eating them. The oil is much used in Russia and China for culinary purposes. The seeds are spread and turned to prevent fermentation. When grown for seed, the plant is said to be exhausting, but when pulled green it is a cleaner of the soil. The plant has a strong odor with narcotic and intoxicating properties, and hence is used in India, mixed with tobacco, for smoking, and also in making an intoxicating drink, *bangæ* or *gunjah*, and this is likewise much in use in Egypt. The seeds preserve their vegetative properties only one season, on account of their oil. If this be rancid the seeds will not germinate, or if they be white or pale. The seeds are sown broad cast, more or less thick, according to the use intended. If thick, the fibres are fine, have a better lustre, are more easily bleached, and make a finer cloth. When sown thinly, it is coarser and better for cordage. It should be thinned and cleared of weeds.

Some remarkable properties are said to belong to hemp. Besides

the narcotic and intoxicating effects we have noticed, strange phenomena have been attributed to the use of the expressed or distilled juice. The *gunjah*, a spirit or tincture prepared from the hemp in the East Indies, having been administered lately to some young persons, it is reported that ten drops of the tincture induced, in a lad, the most wonderful effects. He could recognize none of his acquaintances, they appearing as perfectly changed as was his own mind. He enacted the part of a Rajah, in which he gave orders to his courtiers in the most accomplished manner, described his former associates and teachers with truly dramatic effect, detailed imaginary travels in former years, gave the particulars of his wealth and power, and discussed religious, political, and scientific subjects with astonishing eloquence, and disclosed an extent of reading and readiness of wit far beyond his known abilities. This was continued for three hours with an ease and dignity perfectly becoming his imaginary situation, when it was suddenly terminated without occasioning any unpleasant effects. The effects are spoken of as resembling those produced by the inspiration of the Delphic oracles. Frequent gigling, a peculiar gait, a constant rubbing of the hands, and a propensity to caress or chafe the feet of by-standers; and, in some cases, violent passions and a voracious appetite are mentioned among the effects produced.

The Sythians are said to have cultivated the hemp, to have made garments of it, and to have thrown the seeds on hot stones, and inhaled the perfumed vapor, which excited feelings of great exhilaration. It is, and long has been, known in India as the "assuager of grief, increaser of pleasure, increaser of desire, cementer of friendship, causer of a reeling gait, the laughter mover," &c. The India species (C. indica) is thought not to differ from the common hemp except in some peculiarities of appearance. The parts used for intoxication are the resinous juice from the leaves, small stems and flowers. It is collected by men dressed in leather running through the hemp, thus brushing off the soft resin and afterwards scraping it from their cloths and making it into balls. A finer kind is collected on the naked skin; and in Persia, by pressing the plant on cloths, then scraping it off and melting it in a pot with a little water. *Gunjah* is the dried hemp from which the resin has not been removed; it is sold in small bundles in Calcutta for smoking. *Bang* is the larger leaves and capsules. The leaves of the common hemp yield a volatile oil, resin, &c., these being thought of some medicinal importance.

When distilled with water the liquor has the powerful narcotic odor of the plant. 10 grains administered to a dog created complete drunkenness for 2 hours. Its effects on men alleviate pain, increase appetite, and induce aphrodisia and great cheerfulness. To a patient afflicted with rheumatism a grain of the resin being given, he became very talkative, sang, hallooed, and called for food. In four

hours he slept soundly; and, on his arm being raised, *it remained in the position in which it was placed,* exhibiting that extraordinary nervous condition called *catalepsy.* When raised to a sitting posture, or his limbs were moved in any position, his body and limbs remained, like a waxen doll, in the exact position in which they were placed. He thus continued for 7 hours, when he suddenly awoke with all his natural powers of motion. Others, on taking it, were excessively mirthful and elevated. The effects however have not been so remarkable on persons in London who have taken the powder or extract sent from Calcutta. It has lately been recommended for rheumatism, tetanus, hydrophobia and cholera. The extract is obtained by boiling the tops of the dried stalk in rectified spirits, till all the resin is dissolved. The tincture is then evaporated to dryness in a vessel over boiling water and the extract made into pills. 3 grains are dissolved in a drachm of proof spirit and 3 drops given every half hour for tetanus, till the paroxysms cease or catalepsy ensues; for cholera 10 drops each half hour, and for hydrophobia from 10 to 20 grains are chewed and repeated if necessary. The novelty of these effects should induce a trial with our hemp.

The harvest, with the male plant is soon after flowering, and this should be pulled without disturbing the roots of the females, which are three times more numerous, and which are allowed to remain several weeks longer to perfect their seed. The seed stalks are too coarse for lint, but make excellent charcoal for gunpowder, &c. The roots of male plants, and female, if used, are cut off as soon as pulled, and the upper leaves beaten off. Seed crops should be sown in drills. But hemp is now much cut just above the ground.

The process of rotting consists in dissolving the substance which envelops and unites the fibres. For this purpose the stalks are generally placed in pools of water for from 5 to 15 days, after which it is dressed. The water in which it is rotted becomes poisonous to fish and to all other animals, and it should therefore be removed from all communication. Hemp may be rotted by spreading it upon a green sward during the night, and heaping it during the day. If dry, it may be watered at night. But this process requires 7 or 8 weeks. It may be rotted, likewise, by burying it a foot deep in the soil, after being well watered; but this, too, requires a long time, and is unequal to water-rotting. Steeping hemp in boiling water with green soap has been practised. Snow-rotting bleaches the lint; and we suspect steam might be advantageously and expeditiously used for this purpose. The *brake* used in dressing resembles that used for flax, but is longer. A hand breaks from 1 to 200 lbs. per day, and the price is from $4 to $6 per 1000 lbs. The quantity of net hemp to the acre is from 600 to 1000 lbs. This is estimated, while growing, by the number of feet it is high, caculating 100 lbs. for each foot. Hemp is an article that will always command cash.

After rotting and drying, hemp is combed, beaten, or dressed, &c., by machinery or by hand, like flax. It is then spun into threads, which are made into twine or ropes, or wove into canvass and cloth of various kinds. A good cloth is made of it for towels, table-cloths, &c. The cloth is very durable for outside garments for laboring persons; and for finer cloth, it possesses advantages in strength and warmth over flax. Its color also improves by wearing, while that of linen deteriorates.

Canvass is of 2 kinds, the threads in one are worked into squares and wrought into tapestry with the needle, and the other is a coarse stout cloth for the sails of vessels. Much of this is also used by painters, for the ticks of beds, for cotton bagging, etc. These cloths, as imported are called *Russia duck, Russia towelling, hempen Russia,* etc. Indeed the importance of hemp for these purposes renders it scarcely less valuable than cotton.

Hemp and cordage in the U. S. is now regarded as of the utmost importance. The great use now made of hemp in this country for cotton bagging, sail cloth and ropes renders it an object of the greatest value, especially to our increasing navy. The duty on imported canvass and cordage, however, will hardly make it an object to cultivate hemp and manufacture it here into cordage to the extent it merits; the serfs of Russia working for 15 cts. per day, will successfully compete with our countrymen. The value of imported sail duck in 1840 was $615,723; of cotton bagging $310,211; of cordage $102,938, and of twine, thread, etc., $141,973—total $1,170,845. The hemp and flax raised in the U. S. in 1842 was 158,569¾ tons. Some years our importations have been to the amount of $10,000,000.

Canvass for our ships is much obtained and fitted to vessels in foreign ports, thus avoiding the duty upon it. One seventh of the marine of this city, it is estimated, is supplied in this way; cordages, chains and anchors have also been thus obtained. There are but two manufactories of flax duck in this country. 100 bolts of canvass are required for a suit of sails for a ship of 1000 tons, the cost of which here is $16 per bolt and in a foreign port about $11; likewise about 1700 lbs. of bolt rope at 7½ cts. per lb., with 100 lbs. of bolt twine. Our annual consumption of Russia duck is estimated at 40,000 pieces, heavy; 30,000 do. ravens, and 10,000 do. of light. If cotton duck were substituted for this, 2,700,000 lbs. or 6,750 bales of 400 lbs. each would be consumed.

Cordage is also an important article in this country. The use of cotton is now much substituted for fishing lines, etc., and cotton duck is now manufactured to considerable extent. 15,000 barrels of tar is annually used in making cordage in the U. S. of which 10,000, tons are made at the west. About 1,000 tons of cordage are annually imported. There are in the U. S. 388 rope walks, employing 4,464 men

and $2,465,577 capital; and the value of products is annually, $4, 078,306. Ken. has 111, Mass. 51, N. Y. 46, Penn. 39, etc.

In 1840–1, the crops were very deficient in the U. S.; but last year the attention of government was directed to it, and in Ken. and Mo. 700 tons of water-rotted hemp were produced. This, at the price of the Russian hemp, was $200,000, and quite equal in quality to that article. An important discovery is said to have been lately made in the application of waste hemp, costing but 2 cts. per pound, to the making of a strong snow white paper. Hemp has also lately been made into beautiful and durable bonnets—a process having been discovered of making hemp as white as snow. Hemp produces, when planted in drills, from 20 to 40 bushels of seeds to the acre, but sown broadcast, for *lint*, at three bushels to the acre, it produces from 700 to 1000 lbs. of clean hemp to the acre.

Hemp in Petersburg is one of the most important articles of commerce. It is of 3 kinds, *clean* or 1sts, *out-shot* or 2ds, *half clean* or 3ds, and codilla. Of the 1st 2 million lbs. are annually shipped in bundles. England imports annually 374,932 cwt. of undressed hemp, almost all of which is from Russia.

C. Sativa; stem upright, little hairy; leaves opposite, stalked, digitate; leafets 5 or 7, lanceolate, acuminate, serrate; male flowers in loose spikes; female flowers axillary, solitary, but male flowers on female plants, and vice versa.—E. I.



FLAX, *Linum usitatissimum.* C. 5, O. 5. Caryophyllæ, sp. 29, Ds. A. 2-3 ft. This is one of the most important plants in civilized society, though the introduction of manufactured cotton within the past century has rendered it far less important than it was formerly for purposes of cloth. The plant has been cultivated for various purposes from a remote period in Asia, Africa and Europe. Its origin is not known, but it is found wild in Persia, and is supposed to have come into Europe from parts of Egypt exposed to the inundations of the Nile.

There are, beside the common flax above named, the L. perenne, *perennial flax*; L. hirsutum, *hairy flax*; L. reflexum, *reflexed-leafed flax*; L. tennifolium, *fine-leafed flax*; L. angustifolium, *narrow-leafed flax*; L. Galicum, *annual flax*; L. Maritimum, *sea flax*; L. Alpinum, *Alpine flax*; L. Austriacum, *Austrian flax*; L. Flavum, *Perenial Yellow flax*; L. Strictum, *Upright flax*; L. Catharticum, *Purging flax.*

Flax is chiefly cultivated for its use in the manufacture of *linen cloth* and *thread* from the bark. This cloth was made and worn even by barbarous nations at a very early period. The mummies of Egypt

are found enveloped in it, and it is now mostly worn by the people there. Most of the neighboring nations are furnished with it from Egypt. From thence it passed to Greece and Rome. Indeed little other cloth, prior to the comparatively late introduction of cotton, was worn by civilized nations, and most fine fabrics still continue to be made of it in the south of Europe, and imported to this country.

Flax has been an article of considerable export from this country, and also the seed. In 1770, 312,000 bushels of seeds were exported, and the average annual amount for 22 years, prior to 1816, was 250,000 bushels. It being an exhausting crop, much less attention is now paid to its cultivation. The smooth, rich prairies of the West afford, however, a good soil for its cultivation to any extent. The best soil is flat bottoms covered by fall and spring floods, and reclaimed marshes and swamps. Top dressings of plaster, ashes, soot, &c., are important, just after the plant appears. Salt is excellent manure, ploughed in with flax, at the rate of five bushels to the acre. The best paper is made of linen rags, for which they are greatly used.

The cultivation of flax is comparatively small in this country. The value of the manufactures in 1840 was $322,205, and the capital invested was $208,087. The best seed for growth comes from Holland. It is sown in March or April, and pulled in autumn, laid in the sun to dry, then tied in small bundles and laid in a pond of water for 10 or 15 days, by which the bark becomes separated. It is then spread in the sun until dry and brittle, so that the flax easily separates from the stalk. It is then sent to a mill to be broken and dressed, or this is done by hand, in which a handful is taken in one hand and laid on a table or *flax-brake* and beaten, then drawn forcibly over the edge of a board and afterwards heckled or combed on a board filled with iron teeth. Dressing mills are, however, now common, especially in this state, and on an improved principle, so as to dress it in an unrotted state, and at a toll of a tenth. The medium price of flax is 10 cts. per lb. The expense of dressing has been reduced in this country from 1-3 to a 10th its value, and spinning machines are now in use here for making thread and cloth, and nothing is wanting but the application of power-looms to compete with foreign fabrics.

The water in which it is rotted is poisonous to animals. It undergoes various dressings, according to the use for which it is designed. It has not been placed in water in many cases of late, but dew-rotted; by which, it is said, the fibre is much stronger. It is cut and stacked like the grains, after which the capsules and fibres are separated by machinery. The remains of the flax are used as fodder for horses and cattle. The bleaching is effected by steeping the flax in soft soap. Running water is also used, or that of canals, for rotting flax. This is better for the fibre than stagnant water, though double the time is required. In any water, it must be turned once in 3 or 4 days. Boil-

ing or steaming it for 10 hours in salt water, spreading and watering it, is a new and good process.

The seeds are removed with long combs, dried, thrashed, cleaned, and pressed for their oil (linseed oil), which is of great value for making paints, for medicinal preparations, for making green soap, for varnishes, &c., and the *cake*, after the oil is expressed, is one of the most valuable articles as food for fattening cattle, and for broken-winded horses. A decoction of the seeds is used for coughs, and a variety of disorders; and when powdered, a common and valuable poultice is made of them. Equal parts of lime-water and linseed oil are one of the best applications for burns. In times of scarcity the seed has been used for human food, but it is heavy and unwholesome. 8 or 10 bushels of seed and 400 lbs. of flax are the product of an acre of good soil. The American seed has a high reputation abroad for flax. England imports annually over 2 million bushels, and the amount of linseed imported in 1840 into this country was $173,830. The amount of flaxen dyed and colored goods was $113,662, and of other manufactures of flax $321,684. There are 143 oil mills in the U. S., and the value of export of flax seed was $120,000.

One or two of the other species are cultivated. The New Zealand species is used by the natives for cords and clothing; it is stronger than any other species or any other vegetable, and is almost equal to silk. The stem is 6 feet high, and is adapted to any kind of soil. The fibres are long, snowy white, and lustrous. The cultivation of this is being introduced into Europe and the U. S. The common flax is said to deteriorate if continued long in the same soil and without changing the seed. There are three varieties commonly cultivated. The 1st is tall and slender, with few flowers; it ripens late, and affords the longest and finest fibres; the 2d has numerous flowers, and is best for seed, but its fibres are short and coarse; the 3d is the most common, and is intermediate between these two. The seeds of these varieties should not be mixed, as they ripen at different times, and should be sown at different intervals. When a few inches high, flax should be cleared of weeds, especially of a parasitical plant with small white flowers, which should be pulled and burned. To prevent flax from falling, lines are often stretched across the field, and when it begins to turn yellow it is pulled. A superior method of preparation is said to be to dry and store it till October, then put it in soft clear water till the fibres are separated with some difficulty, then spread it on grass for the frosts to complete the operation, and when dry, secure it immediately.

The composition of linseed is *fat*, *oil*, *wax*, acrid *soft resin*, resinous *coloring matter*, yellow *extractive* with *tannin* and *salts*, sweet *extractive*, with *malic acid*, *gum*, *mucilage*, *starch*, *gluten*; and the ashes contain oxide of copper. The mucilage of linseed resides in the seed.

coats, and is extracted by hot water; its soluble part is 52, and insoluble part 29, with ashes and water. It is emolient, demulcent, laxative, and nutritive, and is employed to allay irritation, as a tea. The seed is bruised with Liquorice root and steeped in water by the fire, strained (sliced lemon and sugar are added), and used for pulmonary and urinary, and other membranous irritations. Seeds yield 18 or 20 per cent. of oil by cold expression, and 22 to 27 by aid of heat. When exposed or heated it dries and is called *drying oil*. The elements are carbon 76, hydrogen 11, oxygen 12. It is rarely employed internally. For a poultice it is powdered and boiled.

L. ussitatissimum; calyx leaves ovate, acute, 3-nerved; petals of corolla crenate; leaves lanceolate; stem erect, smooth, leafy; flowers on stalks, erect, sky-blue, &c.—E. I.

IMPORTANT VEGETABLE SUBSTANCES.

MULBERRY, *morus multicaulis*, C. 21, O. 4. Erticea DT.

This is a variety of the *morus alba*, or *white mulberry*, and is celebrated as the food of the silk worm, which, with its product, are mentioned below. The other species of the mulberry tree will be described hereafter. This species often grows to the height of 40 or 50 feet. The mulberry is greatly cultivated in the south of Europe, the E. Indies, and America, for the silk worm, though the black mulberry is used by the worms in parts of Spain and Persia, and both are grown in China for this purpose. Plantations are numerous and large where silk is produced. In this country speculations in this plant from 1836 to 1839 exeeeded all bounds, and the disastrous failures in the latter year were but the natural result of such a state of things. But the present more steady and rational increase in the cultivation is promising of equally steady and permanent prospective results. In parts of Europe the plant is grown like willow for baskets, and in the same soil; and in the East as low bushes which are rooted up and renewed every three or four years. The leaves are stripped off the young shoots in some places for the use of the worms, and in others the shoots are cut off. The plants are raised from seed, but commonly from cuttings put down in the spring. An ounce of seed produces 500 trees. The Italian variety is often grafted on seedling stock of the common sort, to prevent degeneration. In the E. Indies it is raised from cuttings, 3 or 4 being placed together. The plant is now naturalized in Europe and the U. S. The leaves are thought to contain less water and more nutriment in warm climates. The white mulbery flourishes in this country as far north as the 43d deg., and south as far as 36°.

M. alba; leaves alternate, obliquely ovate, somewhat heart-shaped, nearly smooth; stem whitish, copiously and irregularly branched; flowers green, in shortish spikes. China.

SILK. This is the ultimate product of the silk worm, and the primary product of the *mulberry tree*, and one of the most important articles of clothing known in society. It has been classed with agricultural subjects and vegetable productions; a comprehensive view of it therefore appropriately occurs in this place.

The name is from *Sericum, Seres*, the supposed ancient name of the Chinese. The thread is spun by various species of caterpillars or larvæ, of the phalæna genus, of which the *Phalæna Atlas* produces the greatest amount, though the *Phalæna Bambyx* is the species commonly employed. In its first, or caterpillar state, after acquiring 2 or 3 inches in length, it encloses itself in an oval case, or cocoon, formed of fine yellow silk filaments from 30 to 35 feet in length. This is ejected from its stomach in its insect state, prior to its taking the crysalis form. After freeing itself from its silken case, it seeks its mate, which has undergone the same process, and in 2 or 3 days the female deposits from 300 to 500 eggs, when the existence of both is terminated.

An improvement has recently been adopted by J. W. Gill, Esq., of Ohio, which, as he states in a late communication, "Curtails expenses about one half, and more than doubles the quality and quantity of cocoons raised over the most improved method heretofore practised." The name of this improvement is "Gill's Patent Feeding Tent and Silk Worm Ventilating Cradle." "This," Mr. G. says, "I fully believe will work as complete a revolution in the growing of silk as the discovery of the Gin did in that of cotton." The object of the instrument is to remove all impure air about the worms and among the mulberry branches, and also all dry leaves and impurities by the motion of the cradle and its appendages; which motion, he rationally infers, is agreeable to the worms, it being like that of the branches on which they feed in a state of nature. The representations of this gentleman are said to be entitled to implicit confidence. He is one of the largest silk growers in the U. S., having some forty acres of trees, and being largely engaged in the manufacture of silk. The prevailing practice has been, here, to feed in enclosures, but this and other facts prove that *open feeding* and ventillation are essential to the health and productive labors of the worm. 20,000 worms are said to throw off 50 lbs. of impure matter every 24 hours, hence the necessity of ventillation. Hot and sultry weather are said also to be more prejudicial than cold weather.

The Cocoons are collected 7 or 8 days after the worm has enclosed itself, heated in an oven by steam, to destroy the life of the worm, and being then immersed in hot water, to soften the gum, the raw silk is brushed up and reeled off, forming one smooth thread of numerous filaments. The thread from each cocoon is from 900 to 1800 feet long. When dry, this is taken from the reel and made into hanks.

One of the threads being twisted is called *singles*, and two or more threads twisted are called *tram*, which forms the *weft*. *Thrown silk* is formed of two or more singles twisted in a direction contrary to that of the singles, and is called *organzine*, forming the *warp*. This process was long kept a secret in Spain, but was discovered and practised in England in 1562.

Twelve lbs. of cocoons, yielding 1 lb. of reeled silk, are the results of the labors of 2,800 worms, which have consumed 152 lbs. of mulberry leaves. Silk, when thrown, is *hard silk*, and is boiled 4 hours in soaped water, to discharge the gum before dying, and then washed in clear water. Various arts are now adopted in the preparation and weaving of the diversified silken fabrics. Most of the American silk is still used for thread.

The art of rearing silk worms, and making silk, was first known to the Chinese, and was probably introduced at Rome in the time of Pompey and Cæsar, who wore articles made of it. Its cost was then equal to its weight of gold. By a law, however, in the time of Tiberus, no man was allowed to disgrace himself by wearing it. Still, it soon came into use among the wealthy; large quantities were imported, and the price was reduced; so that down to the 6th century it was largely exported from China, and very generally worn. The Chinese date their invention of silk manufacture 2,700 years before the Christian era. The raw material was exported before the insect, and was manufactured in Persia and Tyre. The culture of silk worms was confined to Greece for 600 years.

In 550, two monks, who had resided in China, carried the eggs to Constantinople, where they were hatched, mulberries grown, and the manufacture of silk commenced. The Greeks were skilled in rearing the worms and in making silk until the 12th century, when the art was introduced into Sicily, and soon spread into Italy and the south of Europe. It was introduced into France in 1480, and silk was there soon extensively manufactured. From thence it passed to England in the 15th century, and an association was formed in 1562 for the manufacture of silk. In 1666, 40,000 persons were engaged in the business. Manufacturers from France came in large numbers to England in 1685–6, and the importation of silk also at this time, was near 700,000*l*. In 1719 a great improvement in throwing silk was introduced by Lombe, which formed a new era in the manufacture of silk in England. From this to 1824 the art progressed, though the annual importations amounted to 500,000*l*. The manufacture was, however, greatly checked by the introduction of cotton about 1785, though it continued to progress on the continent; and important improvements were there made in every branch and fabric of the art. In 1826 a great change was effected in England by the abolition of the prohibitory laws; the silk manufactures rapidly increased, and 4,693,517 lbs. of

raw and thrown silk were imported. The exports in 1830 amounted to 437,880*l.*, an advance of more than 300 per cent. over that during the prohibitory laws. This may be thought a strong proof in favor of free international competition in the arts. France in 1824, exported 100 million francs worth of silken goods. Both England and France are furnished with much raw silk from Spain.

In the U. S. great efforts have been made to produce and manufacture silk, our climate and other circumstances being highly favorable for these purposes; but to compete with the long trained manufacturers of Europe, with a difference of one-half in the price of labor, renders success uncertain at present, unless aided by protective duties. Still, much has been done, and the silk mania a few years since has had the effect to steady and direct the efforts now making to cultivate the mulberry and manufacture silken goods. Every year exhibits progressive improvements; and it cannot be long before we shall have attained eminence in this branch of industry. A bounty is now given in 12 states, and the products nearly double annually, and the manufactures increase with the production of the raw material. In Ohio and other western states the manufacture is rapidly increasing. In New England, too, steady progress is making by practical and enterprising men. Many family machines, besides large establishments, are in operation, and the products are found profitable. The progress in this state has been remarkable since the convicts at Auburn have been employed in the business.

Organzine is worth from $5 to $10 per pound in the gum. 2000 bushels of cocoons are said to have been produced in Tennessee last year. $4 per lb. is now paid for cocoons at manufacturing establishments, and one manufactory in Ohio realizes $1,000 per month, at a profit of 10 per cent. 3 cocooneries there fed 2 million worms last year, which are supposed to have yielded $2000. That state paid $6,699 bounty last year, and the reeled silk amounted to 3000 lbs. The mulberry tree is indigenous to this country, and the worms can be freely raised in every state in the Union. Florida is particularly favorable and is now prepared for the most extensive operations in this important department of our productive industry. The American raw silk, it is said, is superior to the foreign article in brilliancy, strength and scent. The air pump and camphor have been used to destroy the crysilis, by which any injury to the silk is avoided. Other important improvements have been made in this country; and the after growth of leaves has been profitably used in the manufacture of paper. The amount of the silk crop in the U. S. last year was 244,-124 lbs. of cocoons. The amount of silk made in 1840 was 15,742 lbs.; value of the silk $119,814; persons employed 764, and the capital invested $338,754.

Silken fabrics. These are numerous, but all depend on different

modes of manufacture. One of the richest is shaggy velvet, (Italian *veluto.*) The soft shag or pile is produced by the insertion, during the process of weaving, short pieces of silk under thread, doubled under the shoot, and it stands upright on the upper surface so crowded together as to conceal the interlacings of the warp and shoot. This pile gives it its softness to the touch; and the beauty depends on the evenness of the pile and the equality of the threads. *Gauze* is a light transparent fabric formerly brought from *Gaza*; hence its name. The plainest mode of silk weaving has the name of *Persian, sarsnet, gros de naples, ducopes*, &c.; the two first are flimsey textures, and the two last are stouter. *Satin* is a peculiar twill, the soft lustrous face of which is given by keeping a large part of its warp visible. The flossy or warp face is dressed by being rolled on heated cylinders, which gives it its brilliant lustre. *Crape* is a lighter fabric of plain weaving. *Levantine* is a stout easily-made twilled silk. *Gros des Indies* is *formen* by using different shuttles with threads of various substances for the shoot. Watering silk gives to it its peculiar wavy appearance. Two pieces are passed lengthwise through metallic rollers and thus subjected to different degrees of pressure, which causes the wavy appearance. Silk is embossed by passing plain stuff between rollers, the surfaces of which contain the desired pattern, on one cylinder raised and on the other sunk. *Bombasin* is twilled with its warp of silk and shoot of worsted. *Poplins* and lustres are plain woven goods with more silk than bombasin. *Tabby* is a coarse taffety watered. There are numerous other kinds of silken fabrics.

PAPYRUS, *antiquorum.* C. 3.01, Cyperaceæ, sp. 1, 3. A. 10 ft.—This plant grows wild in Egypt, Syria, Sicily, &c. It is an aquatic plant. For paper the inner rind of the stem was cut into strips in parallel and transverse rows, which adhered on pressure, or was pasted, and formed the paper of the ancients for writing upon, as seen by ancient manuscripts. It is now made into sail-cloth, ropes, mattresses, and cloth, by weaving the stems and plastering them with resins. Boats are also made in this way. "The ark of bullrushes," in which Moses was found is supposed to have been thus made of this plant. The floral *thyrus*, used to adorn ancient temples and statues, represented a tuft of the papyrus. The root was chewed as the cypruses now are in Abysinia, and also that of maize. It grows in stagnant water. This plant has given name to the modern valuable article *paper*, also made of vegetables, but very differently from that of former times.

PAPER. As this is a vegetable substance, and chiefly the product of the foregoing plants, *cotton* and *flax*, a brief notice of it, especially since it is one of the most valuable articles in civilized life, may not be without interest. The manufacture and use of paper made from the *papyrus*, was continued down to the 8th century, and was an ar-

ticle of great commerce. At this period it began to be supplanted by cotton paper, though it still continued to be used in Italy till the 11th century. The paper of the ancient Mexicans, before the conquest by Cortez, was made of the leaves of the *Agave*, in a manner much like that of the Egyptians.

Besides these kinds of paper, one was made of the inner bark of trees, and in the 11th and 12th centuries skins were much used. Strips of bark and leaves are still used among the eastern nations, and these are written upon with sharp-pointed instruments, curious specimens of which we have in our possession. The Arabians are said to have been acquainted with cotton paper in 704, A.D., and prepared it themselves from the plant, and exported it considerably to Spain during the 11th century. The first paper mills were there erected, and their products were carried to France and Germany in the year 1300. This cotton paper differed from the linen paper by its loose texture.

The paper of the U. S. is mostly cotton, on account of the abundance of cotton and its fabrics in this country. The Germans were probably the first to add linen to cotton rags in paper making, in the 12th century, and proper linen paper made its appearace about 1318. Documents in Germany, dated 1324–26–31, are seen there upon this paper. None is found in Spain or Italy before 1367. The Chinese to this day have manufactured their paper of hemp, the bamboo, and mulberry. The English, at a later period, brought the manufacture of linen paper to great perfection. The French papers are also of fine qualities. That of the Italians and Germans is durable, but not equal to that of this country.

The manufacture of paper in the U. S. has rapidly increased and in proportion quite equal to the increased demand. In 1829 the quantity made in this country was from 5 to $7 millions, employing 11,000 persons; and in 1840, the importations of paper were $70,267, and of books $210,764. We exported also of paper and stationary $76,957; books and maps $29,632. The number of paper manufactories in the U. S. is 600—457 in operation, with 1500 engines and $16,500,000 estimated capital invested. The amount of rags, junk, canvass and cotton waste used is estimated at 190 million lbs. per annum, of which from 15 to 20 millions are imported, which, at 3½ cts. per lb., is $6,615,000. The number of adults employed in the manufacture is 8,250 and the value of products $5,600,939.

The quality of American paper has greatly improved of late, and the recent inventions and especially that for making paper of any required length by machinery, as rapidly as it can pass off from the machine, places us in advance of any nation in the quantity we are capable of making. Immense quantities of wrapping paper are made and much of this is now made of corn stalks, straw, the refuse of hemp, &c.

Coarse paper is also made of the pine tree and from several other vegetable substances. The process of paper-making is generally understood or it may be readily seen by most of our readers.

The manufacture of white paper was first made in England in 1690, and in 1721, 300,000 reams were made, and in 1783 the value of the paper made was 780,000*l*, and in 1830, 1,200,000*l*. There were then 800 paper mills in the kingdom and 25,000 persons employed. But the manufacture is loaded with an excise duty *three times as much as the whole wages of the working people employed!* This duty on first class papers is from 25 to 30 per ct. and on the finest 200 per ct.! Mc Culloch says that one-third of the books and nineteen-twentieths of the pamphlets do not pay expenses. The publisher pays the duty on every book of an edition before he brings one copy into market; and upon an advertisement announcing the sale of a six-penny pamphlet, the duty is as great as upon one for the sale of an estate worth 100,000*l*. The annual revenue from paper is over 700,000*l*, and the paper charged with duty is over 60,000 cwt. A paper maker says he is obliged to give from 24 to 48 hours notice to an excise before he can move a ream of paper and to keep it 24 hours afterwards, before he can send it to market. Every room, vat, engine, chest and press must be numbered and every ream of paper labelled. Should one label be lost, the penalty is 200*l*. He orders 500 labels at a time and should any person steal or destroy them, the penalty is 100,000*l*! This is in addition to his yearly license and all his other taxes. "Such," says McCulloch, "is the encouragement given to literature, such the facilities afforded to the diffusion of useful information by the popular government of England!"

Paper, in its dimensions, is *atlas*, *elephant*, *imperial*, *superroyal*, *royal*, *medium*, *demy*, *crown*, *foolscap*, *pot*, or *letter-note*, &c. *Wove* paper is made in moulds; *blotting paper* is made of woolen rags without sizing; *pasteboard* is made of many sheets pasted together; *mill board*, used for book covers &c., is made of coarse materials, as old ropes &c. All of these are bleached, when required, by chloride of lime, solphuric acid, or a mixture of this and sea-salt. Marbled paper, paper hangings, and many other kinds are now chiefly made in this country. Paper is made up into *sheets*, *quires* and *reams*, 24 sheets making a quire, and 20 quires a ream.

TOBACCO, *Nicotiana tabacum*. C. 5.01. *Solaneæ*, sp. 14-26. A. 4 ft. This is also called the *Virginia tobacco*, it having been first discovered there by Europeans. The generic name is from *J. Nicot*, embassador from France to Portugal, who obtained the seeds from a Dutchman who procured them in Florida. The name *tobacco*, which has superseded all others is a corruption of *Tobasco*, a province of Mexico, *Tobago*, or *tabac*, an instrument used by the natives of S. America for smoking the herb. The species grown are, N. tabacum



and N. rustica. We have else where noticed *Betel*, a plant of the E. Indies, as being used in a manner like that of tobacco and as the only rival of this celebrated weed. The first of these species, or *Virginia tobacco*, is the most popular narcotic in use, not excepting perhaps opium. It was taken from this country to England in 1586 and the smoking of it was first introduced by Sir W. Raleigh. The plant is now to be seen on his arms at Islington, Eng.

The smoke of burning vegetables has been used to produce intoxication, or for medicinal purposes, from very remote time. The Babylonians intoxicated themselves in this way, and the efficacy of smoking certain plants for diseases, is mentioned by Pliny. Tobacco has been cultivated for these purposes by the natives of this continent from time immemorial. It is thought that the Asiatics may have known it before the Europeans obtained it from this country. The exhibition of segar smoking to an European was first witnessed among the natives by Columbus on his arrival at Cuba, in 1492. Toledo took the seed from that place to Spain and Portugal, from whence John Nicot sent the seeds to France.

Description. Tobacco is of a brown color when cured, strongly narcotic, with a bitter and nauseous taste. The *Virginian* is the strongest kind and therefore best adapted for smoking in pipes for snuff and for medicinal use. The Maryland is milder and better for cigars; the *pale cinnamon* being best for these. The Kentucky is intermediate between the two. But the Havannah tobacco, N. Rapanda, excels all other for cigars; it is of a yellow brown color, with a musky or spicy odor and light yellow spots on the leaves. There are various other kinds in the European market. The *Amersfoort*, a Dutch tobacco, is very mild, but lacks flavor. There are several German varieties. The Asiatic is not in much repute. The *Manilla* is much esteemed for *sheroots*, as well also as the *Mexican*. There are several kinds in the East Indies and Turkey, but none have the reputation of the American tobacco. The cultivation is restricted in England to "not more than half a pole in a physic, university or private garden." *Nicotia Rustica*, green tobacco, is cultivated in Europe; and the Syrian, Turkish and other tobaccos are prepared from it. N. Persica is a delicate and fragrant tobacco of the east.

The composition of 100 parts of tobacco is *water* 88.280; *bitter extractive* 2.87; *Lignin*, with a trace of *starch*, 4.969; *albumen* and *gluten* 1.308; alkaline and other *salts* 0.734; *gum* with *malate of lime* 1.74; *silica* 0.88 and traces of several other substances. The

expressed juice yields, beside these, *woody fibre*, *oxalate* and *phosphate of lime*, with *oxide of iron* and *silica* in the ashes. The manufactured tobacco yields, in addition to these, *carbonate of ammonia*, and *chloride of calcium*, produced probably by the salammonic used to give it pungency. *Nicotina*, a volatile alkali, exists in the leaves roots and seeds. It acts as a narcotic poison on insects; it is inflamable and has an acrid and burning taste. *The concrete volatile oil* of tobacco is obtained by submitting the leaves with water to distillation. 6 lbs. of leaves yield 11 grains of oil, swimming on the surface of the liquid. The oil is a solid, soluble in ether and caustic potash. *The empyreumatic oil* of tobacco is scarcely distinguished from that of the fox-glove. *Tobacco smoke* is composed of *carbonate and acetate of ammonia, nicotianin, empyreumatic oil, soot, moisture*, &c. Several gases, water, oil and resin, with several acids, are obtained by the distillation of tobacco.

The physiological effects on carnivorous animals, are nausea, vomiting, sometimes purging, trembling, staggering, convulsive movements, and stupor. 5 drachms of rappee introduced into the stomach of a dog, secured by a ligature on the œsophagus, caused death in 9 hours, and 2 drachms applied to a wound killed one in an hour. An infusion thrown into the rectum paralysed the heart, and death ensued in a few minutes. Its effect on the heart is through the nervous system, solely. The effects on the herbivora, as with other poisons, are less marked. 4 ounces given to a horse produced no very remarkable effects.

The effects on man are a sensation of heat in the throat and stomach, nausea, and a peculiar giddiness. It is thought to promote absorption, as dropsical swellings often disappear by the use of it. In larger doses it produces a distressing sensation at the stomach, cold sweat, enfeebled vision, laborious breathing, &c.; and in excessive doses, beside these effects, convulsions, paralysis, and death. Taken as snuff, it blunts the sense, alters the tone of the voice, and sometimes causes dispepsia, &c. Smoking produces similar effects. With moderate smokers thirst is induced by the increased secretion of saliva. It tranquilizes the mind, and hence its general use. Some medical writers say that they know no ill effects arising from the practice, while others describe many. As a prophylactic against contagous or epidemic diseases, it is believed to have no special virtues, as has been supposed. Chewing is attended with effects like those above noticed.

The operation of tobacco is like that of *Lobelia inflata;* it also agrees with foxglove in enfeebling the action of the vascular system, though much inferior in its power. It promotes secretions, and relaxes the muscular fibre. It differs from *beladona* and *stramonium*, and is thought by some to produce effects not unlike those of *aconite*. Its effects in relaxing the muscular fibre renders it a valuable antispas-

modic; and, jointly as a purgative, it is very useful in alvine obstructions. It is not otherwise remarkable for its curative or therapeutic properties. In colic, hernia, tetanus, consumption, ileus, &c., its efficacy depends on its powers of relaxing the muscles. In spasmodic asthma it has been found useful in the form of smoke. Topical applications, in cases of gouty and rheumatic inflamation of the joints, and some skin diseases, are said to be serviceable. Tooth-ache has been relieved by the smoke, and it is said that tobacco promotes the growth of the hair. It is seldom administered in substance, the *wine* of tobacco being used for all internal purposes. But all the uses of tobacco require great caution. Vegetable astringents and acids are the best antidotes to its effects, such as an infusion of nut-galls, green tea, also sour fruits, coffee, &c. The wine is made by digesting the leaves for 7 days, straining and strongly expressing the residuum, and filtering the liquor. It is boiled with lard until friable, and strained, when applied to ulcers, but the application must be made cautiously.

The properties of tobacco are generally narcotic and stimulating to the whole system, especially on the stomach and intestines, to which it proves an emetic and cathartic. The smoke may be administered as a clyster, and an infusion of the leaves forms a powerful lotion for obstinate ulcers. The oil applied to a wound is extremely poisonous, and almost as fatal as the bite of the rattlesnake. This property of tobacco is made available in destroying insects in gardens, in the form of a decoction, powder, or smoke; it is also used, much diluted, to cure cutaneous eruptions in domestic animals. A quantity of tobacco ought to be raised by every cultivator to exterminate insects. A decoction of the stems or poor leaves diluted with water, or a gallon or two of water from a tobacconist, thrown with a syringe upon peach and other fruit trees, effectually destroys insects. In destroying lice on cattle, and ticks on sheep, its importance is well known. Its use gives pleasure alike to the savage and the philosopher, the people of the torrid and the frozen zone, and for no other reason than its stimulating effects.

A hundred volumes, the titles of which have been preserved, have been written against the use of tobacco, but with no other effect, one would suppose, than to increase its use. Could a great moral movement be made, like that now prevailing in this country and parts of Europe, against the use of ardent spirits, and now controling willing millions of people, we might anticipate equally important results. This, alone, could accomplish the great and necessary reform. Its use is certainly a strange propensity in man. Its entrance into the dominions of the Grand Duke of Moscow was forbidden under pain of the *knout* for the first offence, and death for the second. James I. wrote a celebrated work, styled "*Counterblaste to Tobacco.*" The Emperor of the Turks, the King of Persia, Pope Urban 8th, and others, have

issued edicts against its use, but with no better success than those issued against coffee and Jesuit's bark, or any of the denunciations against the potato and many other vegetable productions. All the sovereigns of Europe now derive a large portion of their revenues from tobacco.

Tobacco is cultivated as far north as Sweden in Europe, and Vermont in the U. S., and likewise in the hot climates of S. America, China, Japan, and other parts of Asia. N. rustica, or green leaf, being considered hardier than N. tobacum, it is some cultivated in more northern latitudes. Its growth is prohibited in England, except as a border flower for curiosity, or by gardeners for killing insects, but an enormous revenue is derived from its importation. In Germany and some northern countries, families having gardens, grow sufficient for their own use, but being unable to cure it, they seldom make it into snuff or chewing tobacco.

Cultivation. Tobacco is commonly raised on beds early in spring, and when the plants have grown 4 leaves, they are transplanted into fields, and placed 2 or 3 feet apart. They are then daily examined to discover and destroy a worm which infests them; and when 5 or 6 inches high, they are hoed or hilled up. After acquiring 8 or 10 leaves, and are ready to stalk, the top is taken off that the leaves may become larger. The buds at the joints are subsequently plucked off, and the plant is constantly examined for a caterpillar which appears on the leaves. When the leaves become brittle, the plants are cut even with the ground; and after laying for a time, they are taken to a shed and hung up in pairs, and separated on poles to dry and sweat. When wholly dry, the leaves are stripped off, tied in bundles, laid in heaps, and covered with blankets; care being taken that they do not become overheated, by spreading them out occasionally. When no more heat is perceived they are packed in hogsheads for market.

Manufactured tobacco includes the three different forms of *chewing*, *smoking*, and *snuff* tobacco. *Cut tobacco* is used for smoking in pipes and also for chewing. Of this *shag* is preferred. *Returns* is a lighter and milder kind and is the shag recut. *Bird's-eye* is the same, except that the ribs of the leaves are cut with it. *Canister* is a favorite European, or Spanish smoking tobacco. *Roll or twist* tobacco is mostly for chewing. Of this there are *pig-tail, negro-head, bogie, alloe, cavendish, ladies and Irish twist.* *Cigars* are of various kinds and qualities; the Havannah and American are distinguished from sheroots, which were originally from the east. Of these the *Manillas* are the best. Snuffs are made of fermented tobacco, it being laid in heaps for a month and sprinkled for that purpose, by which ammonia is evolved. It is then ground in mills; and all the varieties are produced by different modes of preparation. Snuffs consist of *two* kinds, *dry* and *moist.* The one is dried at a high temperature, lime being

sometimes added, and the other is the *rappee*, to which pearl-ash is often added to preserve the moisture. These are of 3 kinds, the *simple*, the *mixed* and the *scented rappees*, each with several varieties. Sea salt and salammoniac are said to be added in the various preparations of tobacco, also liquorice and molasses.

The process is first by washing out any sand or decayed parts of the leaves. These are then sprinkled with salt and water or other soluble substances, according to taste. The midrib is then removed and the leaves are placed together and watered with any desirable mixture. They are then rolled with the hand into cigars, or laid on a machine having a revolving knife, and cut into fine shreds for paper or chewing tobacco; or when dried, they are ground into snuff in a mill for that purpose, with the addition of perfumes to distinguish kinds, etc. In the two last processes more or less of the stems are mixed. In the southern states, where the *head* or *plug* tobacco is made, the leaves, after several preparations in which treacle and sweetly scented flavors are used, are rolled and pressed into the required form of the plug or head; again pressed closely into casks or barrels and submitted to heat in ovens or kilns when the mass is thoroughly sweated. In this country the latter kind is mostly chewed in the south, while the *cut* or *paper tobacco* is chiefly used in the middle and northern states, where it is prepared. Little of the latter is exported. The principle kinds of snuff are the *rappee, Scotch, or Spanish, thirds, yellow, black*, &c. These are variously granulated and scented, constituting numerous varieties. There are several species of tobacco growing wild in this country, which are smoked by the Indians.

The tobacco of the U. S. constitutes one of the principle staple articles of production and export, being inferior in this respect only to cotton, the grains and sugar. Its growth is limited, except in comparatively small quantities, to 6 or 8 states. It is the great staple of Virginia and Maryland, and is largely cultivated in Ken., Tenn., and Mo. The crop of 1842 was but about ⅔ of the average crop, while that of 1841 was a large one. The product depends essentially on the weather. The usual annual average crop of Virginia is 50,000 hogsheads. Nearly one-tenth of the whole population of this country are said to be engaged in the culture of tobacco, two-thirds of which are in the states of Va., Md., Ken., and Mo. The value of manufactured tobacco in the U. S. in 1840 was $5,819,568; the number of persons employed 8,384, and capital invested $3,473,191. The crop of that year was 219,163,319 lbs. In Ken. there are said to be 5,000,000 acres of land on which tobacco may be raised at the rate of 600 lbs. per acre, the products of which would be 3000 million lbs. In Mo. and some other states there is probably the same amount of land which may be thus appropriated, so that the reader may easily calculate the quantity which may be produced in this country. Increasing attention

is now paid to the growth of tobacco in Illinois and other western states, and also in N. England.

The product of the U. S. last year is estimated at 194,694,891 lbs, and the value of our importations of cigars and snuff was $869,833; $399 only of which was for snuff; while the amount of our exports of tobacco was $9,883,957. The whole amount furnished elsewhere than in the U. S. is estimated at $150 million lbs. and the amount which might possibly be consumed if grown in the U. S. is estimated at 1,000 million lbs.; so that we raise but a fifth part of that amount; yet we see that the land which may be used for the growth of tobacco in Ken. alone, would afford three times the whole amount, and our revenue would be increased $120 millions. From 1821 to 1840, exclusive, there were exported from the U. S. 1,792,000 hogsheads, valued at $131,346,514, or an annual average of 89,600 hhds. at $6,567,325 per annum. During the above time there were exported 788,477 lbs. of snuff and 57,196,254 lbs. of manufactured tobacco, valued at $5,556,581. During the last 10 years the excess over the first 10 was 143,510 hhds. or $17,567,932; the annual average export of the first 10 was 82,424 hhds., or $5,688,929 and of the last 10 96,775 hhds., or $7,445,722. During the whole period the average price was $73,21 per hhd., and during the first 10 years it was $69–11, or 5¾ cts. per lb., and the 2d 10 $76,83, or 6-40 cts. per lb.—average 6-10 cts. estimating the average weight of the hogshead at 1,200 lbs.

Of the above products during the 20 years there were exported to England 524,640 hhds., at $50,194,466; to France 146,824 do. at $16,361,346; to Holland 423,707 do. at $21,907,465; to Germany 373,918 do. at $18,734,186, and other countries 322,901 do. at $24,149,051 —total 1,792,000 hhds. at $131,346,514.

The increase in exports to England during the last 10 years over the first 10 was 40,802 hhds., and the annual average for 20 years was 26,232 hhds, at $2,509,723; the increase to France was 15,190 hhds. or an annual average of 7,341 hhds. at $818,067; to Holland there was a *decrease* of 13,651 hhds., and the average annual export was 21,185 hhds. at $1,095,373; to Germany the increase was 94,888 hhds.; average annual export 18,695 hhds. at $936,709, and to other countries the increase was 6,281 hhds. Gibralter of the "other countries" averaged for the 3 last years 5,130 hhds.; Sweeden and Norway 1,564; Belgium 1,255; Italy, 1,660; Cuba 769; Africa 1,108; Spain 1,067; Scotland 854 hhds.

The duty paid in Great Britain in 1840 on manufactured tobacco was 3,525,956*l.*, or $15,655,244.64. While the value of the whole exports from the U. S. in 1840, to *all* countries, was but $9,883,957. Of this 11-12th are drawn from the working classes. This duty (beside an additional duty of 5 per cent. on the duty), is 2s. per lb. on tobacco from the British American possessions, and on that from other

parts 3s., or 70 cts. for what is received from us at 6 cts.; on snuff 6s., and on cigars 9s. per lb. It is not suprising that, with these enormous duties, smuggling is extensively practiced. 120,884 cwt. of tabacco, and 169,777 lbs. of cigars paid duty in England in 1840. The rate of duty naturally affects the consumption. This being, in 1841, 3–1-8-10ths, the consumption per head being 12–4-5ths.

Since May, 1840, the duty in Great Britain on tobacco is about 75 cts. per lb., or *twelve hundred per cent.* on our price; in Austria about 60 cts., or 1000 per cent.; in Prussia 30¼ cts. per lb., or over 500 per cent.; and in France $1 per lb., or 1,666 2-3 per cent! Taking therefore our annual exports at $9,225,145, the duty annually levied on this article of our produce alone is $32,462,546; so that the tobacco sells, exclusively of freight and charges, for $41,688,685, of which the American farmer receives *one* fourth, and foreign governments *three* fourths. This tax in England, including 50,000*l.*, or $222,000 imposed for licenses and charges of collection, &c., at 270,000*l.*, or $1,198,800, with the duty, as before stated, at $15,655,244, amount to $17,086,044, or near *two-thirds the expenses of the British navy*, or *three-fourths the expenses of the whole government of the U. S.* France derives a revenue from it of $11,013,333, beside $204,490 from 2,500 retailers.

This duty is *British reciprocity* in commercial trade. The labor of the people of the U. S., exported to different nations, amounts annually to $90,000,000, and pays an average tax of over 50 per cent., while the productions of European nations annually imported into the U. States, amounting to, say 100 millions per annum, are taxed not over 25 per cent. Thus foreign nations receive, as revenue, from our labors and agricultural products, $90,000,000, while they insist (and we comply) on our receipt of their labors at little or no duty. That is, in effect, our farmers pay one-half the amount of their products, for the *privilege* of selling the remainder to European nations, and of allowing them to sell us their arts at a 4th the price we pay them. Or, suppose we sell them of the products of our industry, in value to them, $200,000, and we receive $90,000, the difference in their favor, or in our loss, is $110,000, as duties, for the support of their governments, and we then receive of their arts, $90,000, on which the difference of duty is 3-4ths in their favor. Thus the average duties levied by them on our productions is 6 times as great as the average duties on theirs.

We have availed ourselves of this occasion to allude to the duties imposed on our agricultural products; and what has been said applies to all the staple vegetable productions of which we have spoken, and of which we shall hereafter speak, though not with the same force as to the staple product under consideration. The facts stated are of immense importance to our country, and most intimately connected with our subject, but we have not space for further remarks, nor can

we, in view of these facts, better express our conclusions than in the language of Jefferson: "Should any nation, contrary to our wishes, suppose it may better find its advantages by continuing its system of prohibitions, duties and regulations, it behooves us to protect our citizens, their commerce and navigation, by counter prohibitions, duties, and regulations, also. Free commerce and navigation are not to be given in exchange for restrictions and vexations, nor are they likely to produce a relaxation of them."

HONEY. This is also a vegetable product of much value, the immediate production of the bee, feeding upon the *flowers*, as the silk worm does upon the *leaves* of plants. It was greatly used as food by the people of the east from their earliest recorded history. The ancients seem not to have known its origin. Some believed it a dew from heaven, and afterwards collected by bees; and that the wax only was obtained from flowers. Their poets describe it as running abundantly from the trees during the golden age. It was used by them medicinally as we do sugar, and likewise for making wine, which was given to the soldiers on returning from triumph. The gods of Greece were supposed to live on milk and honey (ambrosia). The Bible makes frequent mention of bees and honey, of grape and tree honey, or that thrown out on certain trees and shrubs.

Honey is secreted by the nectariferous glands of flowers, at the base of the pistil, and is taken up by suction and passed into the œsophagus, crop, or honey-bag, beyond which it does not pass, as it has never been found in the true stomach. It is disgorged at the hive by an inverted peristaltic motion, somewhat altered, doubtless, in its properties. It is used by the bees as food. Its physical properties vary, as to taste and odor, according to the age of the bees and the character of the flowers affording it. A hive that has never swarmed affords the best, which is called *virgin* honey. The flavor of the Narbonne honey, so much admired, is thought to arise from the labiate flowers on which the bee feeds. To imitate this, sprigs of rosemary are added to common honey. Flour is also added, to increase the quantity. This may be detected by its insolubility in water, and by the blue color produced by iodine, which should be used as a test before honey is used medicinally. Mixed with water and fermented, it becomes *mead*, a vinous liquor, much admired by some. It is used for preserves, &c., and served upon the table by itself. Honey is abundant in parts of this country, and in the Isle of Candia. Sicily, and Minorca honey has a superior flavor, and is gathered three times a year. The sage of Europe is said to give honey a superior flavor to that of our country. The honey of spring is better than that of summer, and this is better than that of winter. That of mountainous districts is best.

The chemical properties of honey vary according to circumstances.

It is to be regarded, however, as a concentrated solution of *sugar*, mixed with mucilage, odorous, coloring, gummy, and waxy substances. Its saccharine portion is of two kinds, uncrystalizable, like grape sugar, and crystalizable like the molasses of the sugar cane.

The physiological effects are emolient, demulcent, nutritive, and laxative. It is said, when fresh, to occasion indigestion and colic, and when collected from poisonous plants, to be deleterious. That of particular places has been known to possess deleterious qualities, causing head-ache, vomiting, and partial intoxication; and in larger doses, deprivation of all sense and motion for some hours. Similar effects are described by ancient writers. With flour, and spread on a cloth or leather, it is a good application for the maturation of abscesses. It is used also as a gargle, to promote expectoration, as a vehicle in taking medicinal prescriptions, and as an emolient and demulcent in inflammatory diseases. With barley or rice water and slices of lemon, taken warm, it is excellent for coughs. Mixed with vinegar, in the proportion of 2 lbs. to 1 of the acid, and boiled slowly to a proper consistency, it forms the *oxymel simple* of the shops. It is thus also impregnated with different vegetable juices, and is the basis of several compositions in pharmacy. *Clarified honey* is prepared by melting the honey in water and removing the scum; this, however, injures the flavor and odor of the honey.

Honey Comb, a peculiar secretion by the bee, has been supposed to be the pollen of flowers, but it is a secretion from the ventral scales of the abdomen. With the wax, this *comb*, or hexagonal cells are formed. These are lined by a resinous substance called *propolis*, collected from the buds of trees.



These cells are most admirable specimens of art. The front row shows the cells cut across; the angles of the planes form the roof of each cell, as seen in front. This arrangement gives the most room with the greatest saving of space, work, and wax. Each cell has six plane sides, equal to each other, and strongly secured by a cord around the verge of every cell. The bottom constitutes a solid angle under 3 equal angles. The celerity with which these are constructed, while great numbers are employed, and the formation of 3 or 4 stories at the same time, is worthy of the greatest admiration.

Wax is extensively used in the arts and in medicine. It is extracted by heating the comb with a little water in pans, and constantly stirring it; it is then put in a thin linen cloth, and pressed. This is then *yellow wax*, of a peculiar odor. It is sometimes adulterated with suet or resin, bean or pea meal. The second may be detected by alcohol, in which it dissolves, and the third and fourth by oil of turpentine, in which they are insoluble; the feel and taste of the first are readily re-

cognized. Wax is bleached by melting it in a vessel by steam, and running it off into a vessel placed over water and perforated with holes, and then exposing it to the air a week or two. It is melted again, and a cylinder in the water tank into which it falls, beneath the surface, draws it into ribbons. It is then refined by melting it in water acidulated with sulphuric acid. Spermaceti is added in candles, to improve the color. It is composed of *cerine*, which forms 70 per cent., and *Myricine*. Wax is used, melted with soap, yolk of eggs, or mucilage, for diarrhea and dysentery; but generally externally, as a protective application, and as a constituent of most *cerates*. The vapor from wax placed on hot iron is inhaled for phthisis. 628,303½ lbs. of wax were made in the U. S. in 1840, of which the value of $59,685 was exported.

COAL. This, too is a vegetable substance, the product of primeval vegetation and one of the most important articles with which vegetable nature has enriched the earth and blessed mankind. But, as we propose to continue our treatise on living vegetable existences, our consideration of dead vegetable matter will be brief. The vegetable remains in connection with our subject, and viewed as constituting that highly important substance *coal*, can scarcely be deemed less important to man than the world of vegetable existences we have considered.

The comparatively prodigious exuberance of vegetable nature, during the early condition of our planet, the entombment of innumerable and magnificent plants and the formation of these into immense beds of coal, are one of the most interesting subjects of inquiry which can be presented to the mind of the student of nature. The wonderful changes to which the earth has been subjected and the astonishing transformation of the infinite series of vegetable productions for inappreciable time into vast masses of carboniferous deposits beneath the present surface of the earth, are boldly presented to the mind and they call up a thousand startling propositions and associations. Our limits however will not allow us to go into a discussion of this fruitful subject nor to enter upon an analysis of the causes which have produced these important results. Brief statements of some of the particulars connected with these events are sufficient for our present purpose; and these may lead, as desired, to more satisfactory investigations of the phenomena.

It will appear plain that the deposit of the extensive and luxuriant vegetation which crowned the earth for millions of years, must have produced a vast accumulation of matter and formed strata that, when disclosed at far distant periods, must have undergone remarkable changes in their nature and appearance. Such we find to be the case with the masses of bituminous and anthracite coal from time to time revealed and disengaged from their subterranean beds in this country.

The extent of these strata it is impossible to conceive; but parts of those brought to light by the labors, prompted by the necessities of man, afford a glance at the resources with which vegetable nature has thus supplied the wants of mankind. No example of the providence of nature is more signally remarkable than this. The world of living vegetable existences, when viewed in this connection, appears little more essential to the necessities and happiness of our nature than the world of dead vegetable matter.

The decay of vegetable substances and the conversion of woody fibre into humus, mould or coal, is one of the most remarkable processes in the decomposition of organic bodies. By decay, dead vegetable substances give off the oxygen so essential to their living existence. This takes place when in a moist state and exposed to the access of air, when the air is excluded and when covered with water in contact with other putrefying substances.

It is not possible to explain in detail the processes which vegetable matter has undergone in the formation of coal, during a period extending far, very far, beyond that commonly alloted to the existence of our earth; but proximate causes may be percieved in known chemical phenomena and in a notice of the fact, always to be borne in mind, that the same causes which have heretofore produced extraordinary changes in our earth, are still in operation.

Vegetable substances, on the application of heat, are known to give off their water, while their gummy resinous matter remains incorporated with their carbon. If this heat be gradual, as it undoubtedly has been in the interior of the earth, especially in the latitudes where coal is mostly found, the processes of decomposition of vegetable structures and the combinations of the juices and solid matter of vegetables are especially adapted to the formation of coal. This heat, so important here, is well understood to have existed since the formation of the crust of the earth. It increases in the ratio of one degree for every 60 or 70 feet towards the interior from about 40 feet below the surface, though it differs in different places upon the earth; so that at the depth of 45 or 50 miles it is sufficiently intense to melt or dissolve granitic rocks. But it is not less true that the latitudes in which coal most abounds have been, at a comparatively early period of our earth exposed to a tropical climate, and the superficial heat has therefore facilitated the processes in the production of coal.

Vegetable juices thus exposed to heat precipitate a black product called *extractive matter*, and the action of air on vegetable solids also produces *humus*. Most vegetables acted on by water in contact with other decaying bodies, undergo that slow process of combustion essential to the formation of peat and coal. Peat, indeed, and the gradual carbonization of parts of vegetable remains, like the trunks of trees, are evidences of the progressive formation of coal. When no more oxygen

is admitted to vegetables, much of the carbon is separated in the form of soot or lamp-black; and this would seem to characterize, more especially, the smutty bituminous coals. If the oxygen is not sufficient to consume the hydrogen, other compounds are formed, like coal-tar, or *naphthalin*, as we see have been formed in coal beds in our western states, running into pools or breaking out and overspreading fresh water streams and ponds and often taking fire.

The oxygen of the water of vegetables may have been evolved, as one of the processes in the formation of coal and the inflammable portion, hydrogen, remained. Woody fibre contains a proportion of hydrogen which forms the inflammable principle of some coal, and the color of decayed woody fibre show that both brown and mineral coal are the results of vegetable decay and putrefaction. It loses at the same time its powers of coherance, like linen exposed to heat and moisture, as we observe in bituminous coal. The trunks of decayed trees are found to have given off carbon, while the hydrogen has increased; so that the elements of the water in vegetables have united with the wood and the carbon has united with oxygen and been disengaged.

Liebeg says that coal in all its varieties possesses more hydrogen than wood, and less oxygen than is required to form water, this is proof of what we have before said. The process of the disengagement of carbonic acid still goes on at great depths in coal formations, and hence its escape in what are called *blowers*; and it is thought that mineral springs from this circumstance, have become impregnated with the gas. Gas often passes off in streams from beds of mineral coal. This in volume is composed of 91.36 light carburretted hydrogen, 6.32 of olefiant gas and 2.32 of nitrogen gas, showing that changes in the coal are constantly taking place. The decay and friable character of the upper strata of coal beds is owing to the action of the air by which the hydrogen is removed, and the coal is less combustible. What is termed *wood coal* contains volatile oil, while the carburetted hydrogen is found in connection with mineral, or anthracite coal.

But among the primary causes which have contributed to the formation of coal, is *pressure*. Coal is found in the carboniferous group of secondary rocks including the red sand stones and the formations of mountain limestones. The deposits are called *coal measures*; and, from their form, *coal basins*, or *coal fields*. It is pretty certain that these have been formed in beds of lakes and streams of fresh water, and that they have, after a long interval, been thrown upward by the internal action of heat, more or less violent in its effects. Other deposits were probably formed in the beds of large streams and in the bottom of the sea, where the processes of their formation are still going on. Over these have been gradually deposited innumerable strata of sand and gravel, washed down during countless ages, in which all have become consolidated and have slowly undergone the

peculiar changes alluded to. The agency of pressure and heat in these changes from organized vegetable bodies to anthracite coal, have therefore been apparent in producing the chemical changes which have marked their transformation.

Some of these coal beds are worked at a depth of 1,000 feet; but in this country, there is no occasion to work anthracite to a great depth, as it is elevated and the beds are numerous and extensive. It has been said of the British coal measures, limited as they are compared with those of this country, that "they are the most valuable of all the mineral substances from which Britain derives her prosperity, and indeed may be regarded as the main support of the whole system of British production." If this be true in regard to G. Britain, of how much importance are our vast coal productions to the present and future prospects of our country. The annual consumption of coal in the kingdom is estimated at 28,575,000 tons, giving employment to 200,000 persons. The exports are 7,190,433 tons. There is shipped to London alone 2,638,256 tons by 7,500 vessels. Coal was first discovered in Eng. at Newcastle in 1300, and was first taken to London in 1381; but Edward 1st, supposing it corrupted the air when burned, forbade its use by proclamation. It has been calculated that there is a sufficiency in G. Britain for 3000 years; but this does not appear probable from the fact that they are already worked to an immense depth to supply the present demand; while the vast regions of coal near the surface and yet unwrought in the U. S. render our resources in this respect, truly inexhaustible.

There were raised of *anthracite* in the U. S. in 1840, 850,926 tons, of which 859,676 were raised in Penn., 1,000 in R. I., 200 in Va., and 50 in N. C.; men employed 3,013; capital invested $4,450,112. Of *bituminous* coal there were raised 1,533,015 bushels, of which 622,345 were raised in Va., 620,654 in Penn., in Md. 222,000, Conn. 38,000, and in N. Hamp. 29,920.

The varieties of coal are numerous. These may be accounted for by the natural changes which have taken place in the history of the earth. *The bituminous coals* burn with a bright flame and most freely. They are supposed to possess most hydrogen, while the anthracite is composed mostly of carbon. This does not appear from their combustion to be always the case. The difference may be attributed to the different states of combination in which these elements are found. They are less coherent in the bituminous coals; and the soot given off may be equivalent to the carbon of the carburetted hydrogen burned in the anthracite. The bituminous coals are divided into the *black* and the *brown coals*. Of the latter is the *bituminous wood*, with a ligneous or woody structure and without lustre. *Earthy coal* is less coherent and the particles are loose and friable. The *moor coal* has no ligneous structure and is without lustre; it splits readily on removal. The

common *brown coal* is firmer than most of the varieties, has traces of woody structure, and has a conchoidal fracture, with considerable lustre. Among the *black coals* are the *pitch coal* of velvet-black, but sometimes brownish, with strong lustre aud perfect conchoidal fracture. *Slate coal* has a coarse structure, somewhat lamellar and hard; *foliated coal* has thinner laminæ, and *coarse coal* is similar, with smaller particles; and is somewhat granular. *Cannal coal* has a flat conchoidal fracture in every way, with little lustre; it is harder and smoother than most varieties.

These coals, though divided and possessing different degrees of inflammability, have certain characteristics in common. Some form *coke*, and others are soft on burning, giving off more or less smoke, with different lights, and leaving different products. They are decomposed in a large way to obtain their gases for burning as light in cities. The coked coal is used for smelting metals. All exhibit their vegetable origin, though some are not so distinctly marked as others, or the anthracite. Some are found above the chalk formations, and even in the diluvial and alluvial deposits. They naturally alternate with clay-slate, sand-stone, lime-stone, &c., of the secondary series, and are often associated with animal exuvia, iron-pyrites, &c. They are the coals of Europe, and they also abound in Va., Penn., Ohio, and some other western states.

Anthracite, or Mineral Coal, though classed as a mineral; yet, being acknowledged to be of vegetable origin, it properly belongs to the vegetable kingdom. Its mineralogical character is described as—color greyish and jet black; lustre imperfectly metalic; opaque; specific gravity 1-4 to 1-6 fracture conchoidal. This is one of the best, if not the very best, kinds of coal. Some of the varieties have highly iridescent colors, with a columnar structure, and variable lustre. Its geological position is confined to the transition rocks. It consists chiefly of carbon, with a proportion of oxide of iron, silex, alumina, &c. It is not so widely distributed as the bituminous coals, being little known in Europe, except in small veins, not worth working; but it abounds in the U. S., and during the last twenty years has been consumed in large quantities. It is ignited with difficulty, and it was therefore introduced into use very slowly; but grates being adapted for its combustion, it soon came into general notice and esteem, and its consumption since has rapidly increased, not only for warming apartments, but for all manufacturing purposes; and, more recently, for producing steam. It is devoid of all the smoke and smell which characterises the bituminous coal, and its heat is much greater; so that its advantages are far superior, for most purposes. The extent of this coal in Penn. is well known; it furnishes 2-3ds of the coal consumed in the U. S. It is of easy access, being in hills mostly 200 or 300 feet above the water, and from 15 to 40 feet thick. The beds are mostly

horizontal. Extensive formations of the slate coal—a species of the anthracite, is found on the island of R. I., which is very good for manufacturing purposes. According to estimates there are there 1000 million tons. At Worcester and other places in Mass. this coal also abounds.

POTASH, or *Potassa*, is also a vegetable product, and one of the greatest importance in the arts of life, and as a staple product of our country. Its name is from *ashes* and the *pots* in which the lixivium, from which it is obtained, is boiled; its old name was *Kali, vegetable alkali;* also *salt of tartar, alkali of nitre*, &c. The process of obtaining it is to mix the ley of vegetable ashes with quick lime, and to boil it down in iron pots; the residuum is ignited, and the resulting substance is potash. The purest is obtained from the action, in a red-hot pot, of nitre 1 part, and 2 parts of tartar; the basis of these salts is potash, and the acids previously combined with them are given off. Plants growing remote from salt water yield this alkali most abundantly, herbs more than trees, branches more than the trunks of trees, and leaves more than all.

Potash is commonly obtained from the ashes of almost every species of vegetable, by simply pouring water upon them. This dissolves the salt from its combinations, and the water is then evaporated; the residuum is *carbonate of potash*, and purified, the *pearl-ash* and the *salt of tartar* of the shops. With nitric acid it forms *salt-petre*, or *nitrate of potash*. As an article of commerce it is of a dark grey color, and contains much vegetable extractive matter. After being procured as above, it is heated in a reverbatory furnace, which dissipates the water, destroys the extractive matter, and reduces it 15 per cent. The potash is then white and pure, and hence called *pearl-ash*. It liquefies on exposure; and if adulterated with lime, as commonly, it falls into powder. A highly important alkali *soda* is obtained from sea plants, and used, with others, in the manufacture of glass and fine wares. No class of salts, indeed, is more important in the arts than that afforded by the combinations of potash.

The Greeks and Romans were acquainted with caustic alkalies, and soap was made, says Pliny, from tallow and wood ashes. In combination with acids, potash is found in both kingdoms; in the inorganic or mineral kingdom, combined with sulphur, nitric, silicic, and carbonic acids, and in the organic, or animal kingdom, with phosphoric, sulphuric, nitric, carbonic, and various organic acids; thus being a component of the three kingdoms. In rocks it is more abundant than soda, and in vegetables more than in animals. To purify it, a solution in water is evaporated in an iron vessel, and the hydrate is poured into moulds; or, pour it upon a bright iron plate, when drops rising on the surface become hard on removal, and when hard, put it immediately into bottles with ground stoppers. Pure hydrate of potash is white, extremely

caustic, and dissolves in alcohol or water. Having a strong affinity for water, it liquefies on exposure to the air. It is used in surgery, by the name of *lapis causticus*; it is also much used in chemistry and in the arts. It is the basis of common soft soaps, though not thus used in a pure state. It forms numerous salts with acids; but free, it gives a green color to the infusion of red cabbage, or the syrup of violets, reddens tumeric, and colors blue litmus reddened by an acid. It has 1 atom of potash to 1 of water, 48 to 9 by weight, and 84 to 15 per cent. in quantity.

The physiological effects are its immediate destruction of parts of living plants; on animals it is an energetic caustic poison, and most frequently perforates the stomach. Injected into the jugular vein of a dog, it coagulates the blood, and causes speedy death; but, mixed with blood out of the body, it does not coagulate it, but actually prevents coagulation. On man it neutralizes any free acid, or the phosphate of lime of the bones, where it is applied, and combines with the fibrin and albumen of the flesh, forming *fibrate* and *albuminate of potash;* also with gelatine, and thus acts as in forming soap. It is injurious to the stomach, by saturating the free acids, which are essential to digestion. If insufficient to exert action on the tissues, it is absorbed, and alters the qualities of the secreted fluids, particularly of the urine, so that it is a powerful diuretic; if continued, it acts like mercury, as a resolvent, and the ultimate effects are pernicious, producing scurvy, &c. In water, it is applied for an issue, by washing a linseed oil poultice with a hole in the middle. For the bite of poisonous animals, serpents or mad dogs, it is used with advantage; and also as a wash for ulcers, for destroying warts, to modify the quality of urine, &c. The alkalies, in fine, are used in numerous cases. The *antidotes* are acids or oil, both forming salts with this or other alkalies, and diminishing their causticity.

The decomposition of potash was effected in 1807, by Sir H. Davy, with a galvanic battery. A piece of solid hydrate placed between 2 platina plates was connected with the ends of a battery of 200 double plates, 4 inches square, when it soon underwent fusion, oxygen separating to the positive surface and metalic globules to the negative. This metal *(potassium)* is the basis of potash. It may be obtained by heating potash to a whiteness in a gun-barrel in cotact with iron turnings, the air being excluded, the potassium is liberated and collects in the cold end of the tube. It is immediately placed in naptha to prevent combustion by exposure to the air. 300 grains have been obtained from 24 oz. of crude tartar by a different process. Potassium is the lightest solid known; it is lighter than water, has a color like silver, fuses at 150°, and takes fire and burns rapidly on cold water by combining with its oxygen, and also in chlorine gas. It forms several different compounds. Potash is a protoxide of potassium, and the

numerous combinations which it forms as alkaline salts are of the greatest importance. But as an immediate product of burnt vegetables, and as a constituent of living ones, it has a more special relation to our subject. It is alluded to in the chapter on the agriculture of chemistry as an important agent in soils; and as a staple article of commerce in this country, it is highly important. Of pot and pearl-ashes, the exports from the U. S. in 1830 were 8,957 tons, valued at $1,105,127. The value of the product of 1840 is put down at $533,193 though it is thought to be increasing as our lands become cleared and the trees and herbage are consumed. There is probably a greater quantity exported from this country than from any other, as it can be produced in great quantities only where there are extensive forests.

Vegetables yield potash in very different proportions. In 1000 lbs. of the following vegetables, saline matter is afforded as below—wormwood 748, fumitory 360, stalks of sunflower 349, beech 219, stalks of wheat 198, elm 166, vine 162, fir, 132, heath 115, fern 116, oak 111.

Grasses, leaves, the stalks of peas, beans, melons, cabbages, potatoes, artichokes and maize are very rich in this alkali. Leached ashes forms an excellent manure for damp or clay soils and is used in making black glass. The potash of America affords alkali 857, sulphate of potassa 154, muriate do. 20; in all of which it is richer than that of any other country.

Soda exists in all plants impregnated with marine salt, and many are burned for it, and some especially cultivated. For the manufacture of soda the plants are collected when vegetation has ended, dried and thrown into a pit 4 feet square, previously heated by a split wood fire, and the plants gradually thrown in and the combustion continued for 7 or 8 days, when a block of soda is found in the bottom which is taken to market and used in glass works. From the immense quantity of sea-weed thrown upon our shores, we are inclined to think this might be made a very profitable business in parts of this country. Soda is also furnished to commerce by the decomposition of common salt, converted to a sulphate by sulphuric acid, and this is decomposed in a furnace, when mixed with charcoal and chalk. The most common salts in plants are sulphate of potash, common salt, phosphates of lime and nitrate of potash. The 4 earths obtained from plants by combustion are *silica, lime, magnesia* and *alumina*. Dry plants afford far larger portions of potash than green ones. Saussure's table of the proportions afforded, as found in Chaptal, is the best guide.

ESCULENT ROOTS.

Roots are of different kinds, the *common* spindle shaped, or fusiform root, shooting into the ground, with fleshy fibres and radicals branching from the main stem like the beet, radish, the tree, &c.; *bulbous*

roots with skins like the onion of the alium tribe, and with fleshy fibres, (strictly speaking these are not *roots*,) or *tuberous* roots with fibres in like manner as the potato; and the *parasitical* roots with fibres not fixed to the earth, but attached to trees or other objects.

Succulent roots are the beet, turnip, carrot, parsnip, (the two last are umbeliferous,) skirret, mangel wurzel, &c. These are all *annual* while many other roots are *biennial* or *perennial*. Roots have been noticed more particularly in part I.

The relative proportion of nutriment in these, taking potatoes as the standard, have been stated by Sir H. Davy, as follows, in 1000 parts, of each.

	Quantity of soluble or nutritive matter.	Mucilage	Saccharine matter.	Gluten or albumen.
Potatoes,	260 to 200	200 to 155	20 to 15	30 to 40
Red beet,	148	14	121	13
Mangel wurzel,	136	13	119	4
Common turnip,	42	7	34	1
Sweedish turnip,	64	9	51	2
Carrot,	98	3	95	
Parsnip,	99	9	90	

The esculent vegetables which belong to this class constitute a very important part of human and animal food, though not capable of yielding all the nutrition necessary for the support of man. They are the common auxiliaries of the table in almost all countries, and are very palatable and wholesome, cooked in any of the numerous ways in which they usually are served up. Some are also highly important for the purposes to which their juices have been applied as will hereafter appear, especially for the sugar with which they generally abound. We propose to speak of all the edible roots under this head, commencing with the *potato*, by far the most valuable known.

POTATO. *Salanum tuberosum*. C. 5. O. 1. sp. 79—360. Tr. A. 2 ft. This plant is a native of N. and S. America, having innumerable varieties, and producing a tuberous root of greater dietetical importance than any other esculent root in the vegetable kingdom, and inferior only to the Cerealia.

The Sweet Potato, *papas* (*Conovolvulus Batata*), was introduced into Ireland from New Granada, by Capt. Sir John Hawkins, in 1545; and was cultivated in the South of Europe probably before that time. The common Virginian potato was introduced into England by Sir W. Raleigh and his associates in 1584–6. The first requiring a warmer climate, did not succeed, but the latter was soon brought into use. Sir W. first cultivated it in his own garden in Ireland, in 1610; and such has been its progress there, that it has long constituted from 1 to 2-3ds of the food of the Irish.

The potato was at first esteemed a great luxury in England, and Queen Anne ordered them served on her table at 2s. the pound. In 1663 it was recommended by the Royal Society for the prevention of famine. Indeed, no vegetable production has ever made so much progress in cultivation and consumption as this has within the last 60 years, notwithstanding the great opposition to it. Though not cultivated in Scotland, except in gardens, till 1728, yet the quantity raised there 10 years ago was 12 times that in 1784. In this country the cultivation of the potato has increased with our population, so that the product of the U. S. last year was 136,883,383 bushels.

It was called, in the records of the voyages to this country, *openawk*. The Irish gardner of Sir W. R., on finding one potato of the maturity of "apples," as the result of planting, earnestly enquired of Sir W. if *that* were the fine fruit of Amiriki. Pretending to be disappointed himself, Sir W. ordered his gardner to root out the seed entirely, in doing which, instead of *one*, he found a bushel of potatoes!

The potato was found wild in various parts of America, by the first discoverers, and it still is so found. It grows abundantly in a wild state, near Valparaiso, and along the coast for many miles, where its flowers are always a *pure white*, instead of being colored like the cultivated plant. It has been transported to foreign botanical gardens, where the tubers vary but very little from the common cultivated plant. The attempts, therefore, to make it appear doubtful as to its origin, or as not indigenous to this country, render the fact of its being so the more apparent, and the quibblers the more silly and selfish.

It was brought into use in G. Britain against the strongest and most ridiculous prejudices and misrepresentations of the aristocracy and professional men. Many writers on plants did not even mention it for more than 100 years after its introduction, and not until its merits and cultivation had forced it upon public attention. It had long been extensively cultivated in Ireland, and was well known in Scotland, before it was much used in England.

Religious prejudices were waged against it, it having been maintained that "potatoes are not mentioned in the Bible!" Therefore the same anathema was pronounced against it as was pronounced against "spinning wheels" and "corn farmers." On no subject do men appear so irrational as when arraying their religious prejudices against science and the gifts of nature.

More recently the priests of the Ionian Islands pronounced the potato "the forbidden fruit," and the cause of "the fall of man;" hence its use must be sacrilegious and wicked. Nor were the French without their prejudices against its use, they having rejected a gentleman for cultivating it, and alleged that he *invented* it. Popular favor subsequently set in so strongly in its favor that Louis XIV. and his court wore the flower in the button-holes of their coats. During the dearth of the

Revolution, the cultivation was effectually established. The peasants of Italy were offered a reward by the government before they could be induced to cultivate it; but during a subsequent famine, they refused to receive a reward for that which had saved their lives.

The potato is now generally cultivated in India, China, and the East. But it does not thrive well in tropical climates, below 3 or 4,000 feet from the level of the sea.

The potato came into general use on the continent about the middle of the last century. A royal edict brought it into general cultivation in Sweden, in 1764. In Switzerland it was in use in 1720, and was first made into bread in 1730; so that in 1760 it constituted the food of 2-3ds of the people. In Poland, also, it has become a chief article of food, 85,763,700 lbs. being raised there in 1827. It was introduced into India about 40 years ago, and it is there now extensively cultivated. It is said to be the best gift which the *natives* ever received from their "*European masters.*" In Hindostan it is increasingly cultivated, as there, it is said, no religious prejudices exist against its introduction, as was the case with their enlightened *European masters.* But this plant has forced itself into universal use by its valuable qualities, and is now admitted, even by British writers, as "necessary to the Englishman's fare," and as "*the* plant which seems alone to have been wanted to make the British isles complete." A glance at the products of our country shows the engrossing importance of this vegetable, especially since emigration has become so great.

The cultivation of the potato on the continent of Europe has been rapid beyond example. In fine, its introduction and consumption has had, and will continue to have, a wonderful effect on the condition of the population of the world. It has added millions to Europe, and seems designed, as well from its nature as from the facility of its cultivation, to render unknown the famines of former years. It appears also to be adapted to almost all climates and soils.

The appearance and growth of the potato are too well known to need description. The supposed root consists of many tubers connected to the base of the stem by fibres. The points where the rootlets connect with the tubers to convey nourishment to the plant, are the eyes of the potato, and contain germs of future plants. This plant, unlike all grains and leguminous plants, is secure against late rains, an advantage of the highest importance. Uplands and light soil appear to be better adapted to its culture than strong rank lands; still, new soil produces better potatoes than that which is light and spongy, on account of its moisture, and the large quantity of vegetable matter elaborated so soon, requiring much moisture, and little resistance to its expansion. Side hills and mountains, mostly composed of a mixture of sand and vegetable matter, are therefore best adapted for the potato. Even loose and light soils, with a plenty of moisture, are produc-

tive of this root; and it is its great and peculiar advantage over the grains, legumes, and most other esculent vegetables, that it can be cultivated where no other can be profitably grown, and at small expense, and also, that it is less subject to disease, and more secure against degeneration on such soils than many that are richer.

The propogation of potatoes is commonly by putting them into the ground divided, into as many parts or sets as they have eyes. The blossoms are now often pinched off, on their appearance, this being thought to increase the root an ounce in each potato, or more than a ton to an acre. The plant is likewise propagated by cuttings or layers of green shoots, and by the seeds. The first is only to multiply a rare sort speedily; the second produces few and small tubers at first, but it may improve the quality, and form varieties without number, while the cultivation by the tubers enables one to extend and perpetuate good varieties once obtained.

A nursery system for the potato would be of the greatest importance, for the purpose of obtaining the best seedling tubers. Quite too little attention, it is very evident, has been paid to the improvement of this invaluable esculent in this country. It has been, in fact, for the most part, scarcely fit for swine. Three years being required to bring it forward from the seed, it should be the pleasure, as it is the duty, of every cultivator, to plant superior seeds annually, for the purpose of forming new and improved varieties. Grown on the same soil for a few years it invariably depreciates; so that instead of requiring the least care, as commonly supposed, it requires the greatest care. A new variety, called the *Kelseyan*, or Perfectionist, originating near New Haven, Ct., produced last year from 2 tubers 494 potatoes. The eyes are numerous, and are cut singly, and 3 placed in a hill. It is said to be equal to the Mercer. The Pinkeyes have a very great number of eyes, and it has been thought that two are most productive, and that the stems should not exceed five.

A new variety, called the *Bakewell* potato, is spoken of as of superior quality, even to the *Pinkeyes* or *Rohans*. Tubers will also improve by changes from one place to another.

A disease called the *curl*, or *curl-top*, attacks the plant, during which the top-leaves shrink about the time the tubers should form; the growth ceases and the plant afterwards looks yellow and sickly and the product is but little and that of a bad quality. If the seed tuber be taken up it is found firm and less exhausted than others, showing that it has been too compact for the vegetative powers of the plant. This is avoided by selecting seed tubers which are not quite ripe. The ripe potato has performed all its operations, and becomes inert and worn out with age; but the circulation in the unripe tuber having been arrested by removal from the soil, it starts again readily and with increased vigor when planted. The over ripeness appears therefore

to be the cause of the disease. It is caused also by using seed stock exposed to the light or air during the winter; it should be covered to protect its juices. The eyes of the tuber also vary in this particular, as those nearest the end securing the tuber to the plant ripen first, while those of the other, or larger end, are soft and waxy and best suited for planting. High culture and stimulating manures induce this disease, or it arises from properties left in the soil by previous crops. It is less frequent in new lands and in cold upland places.

The production of an acre of land with the same care and manuring as with wheat, may produce 300 bushels of potatoes, or 24 bushels of wheat. The food of the first, at 38 lbs. the bushel, will be 11,400 lbs. weight, and that of the second at 60 lbs. the bushel will be 1,400 lbs. or $\frac{1}{8}$ of the first by weight. Wheat contains about 3 times as much mucilage or starch and of gluten or albumen as the same weight of potatoes, but it is deficient in saccharine matter, while the potato contains from 3 to 4 per cent of it. It has been estimated that 2 lbs. of wheat are equal to 7 pounds of potatoes, the mean weight being as stated 1 to 8; if, therefore, 480 lbs. of wheat be required for each individual, or its equivalent 1680 lbs. of potatoes, an acre of wheat will sustain 3 persons and an acre of potatoes will support $6\frac{1}{2}$, or more than twice the number.

The average produce in Ireland is considered 82 barrels the acre, or 22,960 lbs. If 4 pounds of potatoes are equal to a pound of wheat, the above amount divided by 4 will give the amount of nutriment as 5.740 lbs. The relative proportion of solid nutriment yielded by an acre of wheat and of potatoes is estimated by Mr. Young as 1 to 3. According to Sir H. Davy, wheat yields 950 parts of nutritive matter in 1000, and potatoes 230 in 1000, the product of an acre of potatoes being 9 tons and of wheat 1 ton; the quantity of nutritive matter will therefore be as 9 to 4 or more than double, so that the population of a potato feeding country, other things being equal, may be from 2 to 3 times more dense than if fed entirely on corn plants. Still, the use of potatoes wholly, cannot be desirable, nor is their accumulation and preservation in quantities without many difficulties. It appears therefore important and desirable that the products of a country should not be wholly one or two kinds, but as varied, if possible, as we find them at present in our own country. The use of potatoes in the composition of bread appears to be greatly increasing. It is said that 40,000 tons of potatoes are annually made into flour, for the purpose of uniting it in the formation of bread, within a circuit of 8 leagues around Paris. The estimated annual product of potatoes and chestnuts in France is 130,000,000 bushels and the estimated annual value of potatoes in the kingdom of G. B. is about 12 millions sterling.

The products of potatoes are various. Alcohol is extracted from

them in considerable quantities in Europe and they are believed to be cheaper for this purpose than barley. In Prussia, where they are greatly cultivated, many uses are made of them. Starch, molasses and sugar are produced from them, the two first being of superior quality. Mixed with wheat flour, curd and salt, potatoes make a light and wholesome bread. Starch is manufactured both here and in Europe, in large quantities by scraping them in cold water. Yeast is also prepared from them, and the seed vessels are said to make a pickle equal to the cucumber.

Potatoes do, indeed, "furnish flour without a mill, and bread without an oven." They are most wholesome and palatable when cooked by steam. They make two kinds of flour by manipulation, gruel and a parenchyma to be used in bread; and chemically, they are made into beer, vinegar and spirits. Cheese may also be made of the flour, reduced to paste, with salt and an equal amount of cheese curd, and formed in moulds. The Germans eat potatoes by slicing, boiling and pouring gravy over them; they are used for salads, with a mixture of anchovies.

The starch makes an excellent paste. Potatoes eaten raw are said to be among the best remedies for and preventives against scurvy. Mashed, mixed and distilled with malt, the spirit afforded is abundant and strong, and by vinous fermentation a good wine is produced. 22½ lbs. of starch are yielded by 100 lbs. of potatoes, and this yields 1¾ gals. of proof spirits.

The tissue of potatoes is cellular and each cell contains 10 or 12 grains of starch. In the cells and intercellular spaces is an albuminous liquid. Boiling separates the cells, the starch absorbs this liquid, and the albumen coagulates in fibres between the grains of starch. When this takes place the potato is *mealy;* but when imperfect it is *doughy* or *watery.*



This cut shows the difference of character and appearance between a raw and boiled potato, which is here represented as cut in two. *a.* shows the cells and the particles of starch, as seen by a magnified power before boiling, with concentric spiral and irregular rings; and also the cells broken with the particles entire. *b* shows the state of the potato and its cells after boiling, as noticed above. The substances of potatoes are *starch, starchy fibrin, albumen, gum, acids, salts* and *water.* A salt *(solarina)* has been discovered in the potato, particularly in the bud which is the cause of the bad effects of germinating potatoes when eaten by cattle. *Diastase* is also found near the bud. The starch in a potato varies with the season. 100 lbs. of potato yield in

Aug. 10 lbs., in Sept. 14½, in Oct. 14½, in Nov. 17, in March 17, in April 13½, and in May 10 lbs. From the spirit of potatoes a volatile oil is produced; and an *extract* from the stalks and leaves is said to possess narcotic properties. Potatoes are less nutritive to cattle in a raw state than when boiled; and they are then laxative and diuretic to man.

The rows of potatoes should point north and south, as they thereby receive a greater breadth and duration of solar light. This is also to be regarded in cultivating other plants. Mr. Knight recommends the planting of whole large potatoes 4 or 5 inches apart, with the crown end upwards. He thinks a luxuriant haulm or herbage is no evidence of a diminished tuber, except when it falls or becomes matted, thereby losing the influence of the sun. *Outside* and *single* rows produce far the largest crops, owing chiefly to their greater exposure to air and light. This has proved equivalent to 58 tons to the acre. Sets or eyes, when planted, should be cut from the crown end or the middle of the tuber, never from the lower or root end and they may be planted nearer together than whole tubers. Close planting in single rows is recommended.

Potatoes produce 1st, *cottony flax*, from the stalk, 2d, *sugar* from the roots, 3d, *potass* by combustion, 4th, *vinegar* from the apples, 5th, *soap*, or a substitute from the tubercles for bleaching, 6th, *spirits* by distilation, and lastly, when cooked by steam, the most farinaceous and economical food of all vegetables. We have described its starch and its employment in bread elsewhere. When given to animals they should be cut in pieces or boiled, which is far better—more nutritive and less dangerous.

Potatoes renewed from seed.—Take the apples when ripe, in Oct. before the frost has hurt them, hang them by the foot stalks in a dry place, so that they will not freeze, till March or April; mash them, wash the seeds from the pulp and dry them in a sunny place. These will produce full sized roots the 2d season. They are sown in a well prepared bed early in May and transplanted into prepared soil, one or two plants in a hill, when 4 or 5 inches high. The tubers thus raised will differ much from those which bore the apple. Plant one potato of the new variety in a hill so as to keep the varieties and the product separate. No variety will continue good over 15 years. The soil should be light and sandy, though rich, for dry and mealy potatoes; not greatly manured.

The more the soil is pulverized the better will be the crop. It should be ploughed deep, as the roots generally grow as low as the soil is stirred. The manure of swine with straw is considered best, as the latter being light, admits air and ferments when the potato most needs it. No crop pays better for good cultivation, though it is often good with little.

In Sweden brandy is distilled from them, an acre of potatoes producing more than one of barley, and a gallon of spirits is produced by 6 pecks of boiled potatoes by distillation. 72 lbs. boiled, are bruised and passed through a riddle with fresh water. The pulp is then mixed with cold water to the amount of 20 gals. To this is added yeast and in 12 hours the fermentation begins and continues for the same time. By stirring it briskly the fermentation goes on for 2 weeks. It is then put into a still, boiled and stirred, the cap put on and the boiling continued till the whole runs over. The taste is like fine brandy. Thus one acre produces 300 gals.

The previous estimate of the nutritive properties may be too low. Some have estimated that 3 lbs. of potatoes are equal to 1 of bread, and that the quantity of food produced by an acre is three times greater than that from an acre of wheat. It is certain that they yield more than double the quantity of food to the acre, and that they are raised at less expense of labor. As the price of labor is estimated by the food mostly used in a country, the labor will necessarily be lower where the laboring classes subsist mainly on potatoes. This is proved by the example of the Irish, both here and in Europe.

The properties of potatoes are various. They are especially nutritious to those who take much exercise, but to those of a thin or spare habit they are not so. They require to be cooked with care. An Irish gentleman says, they should always be cooked in an iron saucepan, and that they should not be peeled when cooked, as much of their nutriment is thereby lost, but only washed and a little scraped at farthest. They should soak for an hour, before being put in the pan, in cold water, just covering them. When the water begins to boil, let a tea cup full of cold water be put in, which checking the boiling, gives time for their being cooked through without breaking. When tried with a fork and found done, the water is poured off, and they are left to stand for a short time over a gentle fire, by which the remaining moisture is evaporated; they are then peeled for the table, and found, if of a good kind, mealy and delicate. Or put them in a pot with cold water, and with the top loosely on; let them boil gradually with the water just covering them. After a time put the top closely on and boil until soft; pour off the water, and drain them in a cullender, then put them on again without water, and dry them till they split.

It has been a question, of late, as to the depreciation of this vegetable. Soil and climate certainly alter their nature, but not more than inattention to their improvement by art. The pieces planted should have at least two eyes, and should be previously dried a few days. About 14 bushels of seed potatoes are required for the acre, and these have often yielded 500 bushels. Potato tops, it is said, cut when in flower, and the juice extracted by bruizing and pressing them, color linen or woollen soaked in it, a fine and permanent yellow.

As few of the early varieties of the common potato produce blossoms, seeds may be procured for changing the varieties by depriving the plant of its tubers as they appear, and keeping the runners above ground by not earthing them, and blossoms and seeds will soon be produced. The flowers of superior kinds should also be plucked to increase the tubers. The rationale of this is found in the fact, that the same sap gives existence to both the tubers and blossoms. This is diminished, of course, by both, and the flower, therefore, wastes a part of the crop of tubers, by consuming the sap necessary to their growth. The importance of plucking the flower, to increase the crop of tubers, and of removing the tubers to improve the seed, and the variety of potatoes they produce, is therefore apparent. And this may answer equally well with other fruit plants.

The varieties are so numerous that it would be needless to particularize them, or the peculiar soil and treatment they require. The ash-colored kidney is in high repute abroad. For keeping, they should be fully ripe and dry, and stored in dry straw, but not in heaps. The Mercer is also a good, if not the best variety. Many others have their advantages.

This extensive genus, *solaneæ*, includes the tomato and egg plant, celebrated in cookery, but not many handsome plants. S. dulcamara has roots which smell like the common potato, but being chewed, it excites at first a sensation of bitterness, and then of sweetness. The berries excite vomiting and purging. The twigs and leaves have been successfully used in rheumatic and scorbutic cases.

S. lycopersicum—a deceitful fruit, is cultivated much about Naples and Rome, for the berries. It is used in stews, soups, and sauces, and makes excellent sauce for fish, meat, &c. This begins to be cultivated in England, but not here, we believe. It is there raised on hot-beds and walls. S. nigrum grows on dunghills, and is narcotic and poisonous. S. pseudocapsicum is cultivated in China for the fruit, served on the tables of mandarins, like our cherries. S. melongena is cultivated in Europe and the E. and W. Indies; and the fruit is used boiled, stewed, and in sauces, like the love-apple.

A plant has recently been introduced into this country from S. America, the fruit of which grows some 15 feet above ground, and has been incorrectly denominated a potato. It is said to possess excellent edible qualities. From a description of it, there is no doubt it belongs to the genus *solanum*, of which there are some 360 species, and probably to the species *lycopersicum*, as cultivated in Italy and the W. Indies, to the love-apple or tomato family, a native of S. America, the S. *melongena*, egg plant, or others of the berried species. A variety answering to this is cultivated in the W. Indies for the fruit, which is eaten, boiled, stewed, in sauce, &c., like the love-apple. These, like all of the night-shades, to which the potato belongs, are poisonous in

a raw state. A specimen of the fruit alluded to may be seen, we understand, at the American Institute in this city, it having been raised from seeds obtained from S. Carolina, where the plant is some cultivated for its nutritive properties.

S. Taberosum. Stems unarmed; leaves uninterruptedly pinnate, entire with 5 or 7 lanceolate, oval leaflets; flowers panicled, large, purplish, or white, drooping, handsome; flower, stalks subdivided.—Peru and N. A.

The Sweet Potato, or *convolvulus battata*, was introduced into Spain from S. America, and afterwards into England, about the middle of the 16th century, from Spain and the Canaries. Its stalks are a pale green, trailing, and extending several feet around the centre. The tubers, in a favorable climate, are very large; 40 or 50 often grow from one plant. The flowers are purple, but the varieties differ in the size, form, and flavor of the root. It often multiplies spontaneously in S. America and the W. Indies, but it is generally propagated by laying down young shoots in the spring. It is of abundant growth, and easily propagated in warm climates. It is much cultivated in the Carolinas and other southern states, and considerably in Va., Md., and N. J. The climate is too cold for it further north. Its consumption increases in the northern states. It is sweet and nutritious, containing more saccharine matter than the common potato, and with most people, it is a favorite food. It may be kept during the winter in perfectly dry places. Efforts are making to acclimatize it in France, and increasing attention is paid to its cultivation both at the south and in some of the middle states.

The seed potatoes are raised in a hot-bed; the sprouts are then cut off and planted in a field of rich soil, 3 or 4 sprouts in a hill; they then grow up so fast as to suffocate weeds. Those with a red skin form a very nutritious jelly with water. "Bowen's Patent Sago," used by the army, is this powder. The roots are grated and the mass washed with water through wire seives of different sizes, then dried in pans. The water in which potatoes are closely boiled is reputed poisonous. Boiling expels the poisonous qualities of many of the most nutritive plants.

Oxalis Deppie is a new vegetable now successfully cultivated in England, but it will soon come into general cultivation. The flavor of the stalk and *tubers* is distinct from any vegetable now cultivated. It was introduced from Belgium, where it is much raised.

This plant is also a native of the E. Indies, but has produced varieties in all warm parts of the earth. It is the potato of Shakspeare and cotemporaneous writers.

Leaves hastate, or 3-lobed; flowers white externally, disposed in clusters on axillary foot-stalks.

BEET, *beta vulgaris*. C. 5.02. Chenopodeæ. Fr. Dh. A. sp. 5-7. 4 ft.—from the Greek letter of that name which the seeds resemble. This is a well known succulent root much cultivated in this country and in Europe where it grows wild. It is a native of Sicily and came to England in 1548. The principal varieties are the *red* and *white*, though there are 6 others cultivated. The former is principally used at table, scraped, in salads, boiled, and cut in slices, as a pickle and stewed with onions; but if eaten in great quantities they are injurious. They are taken from the ground in August, but are not perfected before October. The red beet when boiled, is tender, sweet, and palatable. Deprived of most of its juice and treated like malt, it is found to be a good substitute for barley; and the beer is perfectly wholesome, palatable, and little inferior to that of malt. The beet affords a great amount of saccharine matter, and the French continue to make large quantities of sugar from it. In this country, also, both kinds are extensively grown for the manufacture of sugar, for cattle and for culinary uses.

For sugar, beets are boiled soon after being taken from the earth; and, when cold, sliced and pressed, and the juice evaporated to the consistency of syrup, after which the sugar is obtained by crystalization. 110 lbs. of the root yield 41 lbs. of juice, which, by evaporation, yield 4¼ lbs. of brown sugar, or 4 lbs. of white powdered sugar. The residuum, with the syrup and molasses, yields 3½ quarts of rectified spirits, similar to rum. The manufacture of sugar from the beet does not however compete successfully with that from the sugar cane, though the amount is about the same. The leaves of the beet, raised in rich soil, contain considerable pure nitre, supposed to be derived from the animal matter of the manure. Beside its uses as food for man, it is very valuable for cattle and other animals. The early turnip-rooted beet is good for summer use, the tops being used boiled as greens. Cattle fatten on the sugar beet and cows give more milk for a short time, after which they grow too fat. The *sinclair* beet has large leaves which are tender and excellent, served up as spinnage with the boiled stalk. Beets are preserved as a confection and pickle, and are used as a substitute for coffee. For sugar, the green topped and for salads the small red are preferred. They should have deep, well comminuted soil, and each should have a square foot. Sliced with boiled onions, the beet is a nice condiment, with cold meat, mixed with spices, vinegar and hard boiled eggs. The stalks and ribs of the white are good in soups, for stewing and dressed like asparagus; and the leaves are fine pot herbs. Beets make good pies, when well cooked.

The *mangel wurzel* beet, or *mangol wurzel* of the Germans, is grown principally for cattle; having a larger root and making sugar. The leaves, when young, scraped and boiled and served with butter, are good, and also as spinach. The *silver* or *kail beet*, is mostly culti-

vated now for sugar. The beet requires about 10 pounds of seed to the acre, on the garden plan.

The quantity raised on an acre is from 3 to 500 bushels in this country, though 1000 and even 1600 have been raised. A bushel weighs about 90 pounds; and the root yields 7 per cent of sugar, 3 of molasses and 25 of cake. If the sugar is worth 7 cts. per pound, the molasses 3 and the cake as much as the beet, the produce of an acre of, say 60,000 pounds will be 4,200 pounds of sugar at 7 cts. $294, 1,800 pounds of molasses at 3 cts. $54,—15,000 pounds of cake at 4 mills $90—total, $407,00; expense of cultivation and making sugar, $108,00; nett profit $300.

The beet ("the root of scarcity") is sown in drills, 1 or 2 feet apart, or broad cast, and raked in. When up, 2 or three inches, they are thinned to give room for their large leaves which are excellent, when young, boiled served with butter, or as greens;—never disturbing the central leaves. Beets being pulled, the tops taken off and dried under shelter a few hours, are laid for winter on alternate layers of straw and dry sand, covering the top with 3 inches of sand and a coat of straw, in an open place, or in the cellar. The weather nor insects affect them much, and they prepare the soil for other crops. They are cultivated like other beets. They often weigh from 9 to 16 pounds, and 4 or 600 pounds are raised on an acre. Cattle are very fond of them, and cows fed on them give much milk and cream, and others fatten on them quickly when cut and mixed with clover, &c. Oxen fed with 40 pounds and 10 pounds of hay per day one month, and 50 pounds alone thereafter, are fattened for sale in 2 months. They are equally good for all domestic animals. The culture of beets cannot be too highly recommended, on account of the occasional failure of grass crops. They furnish cattle with a cheap and nourishing forage summer and winter.

When eaten warm, the beet has a mawkish flavor, and it is therefore preferred cold, boiled and cut in slices with vinegar. Sir H. Davy has estimated its nutritive properties to be greater than any other root, the potato excepted, this being 148 in 1000 parts, or about 15 per cent. 12 per cent of the whole is saccharine matter, which is greater than in any other esculent; the amount of this and mucilage is the same in the white and red beet, but the *red* has nearly three times as much gluten; that is, 13 parts and 14 of starch in 1000; and it is therefore one of the most nutritive of the esculent roots. The larger the roots the more tender they are. It is thought to be less apt to produce heartburn, or flatulency, in weak stomachs than any of the succulent roots.

The beet from which the French obtain sugar has a red skin, but it is white within. The white beet is chiefly cultivated for domestic animals in this vicinity, for which purpose it is preferred to the carrot or tur-

nip. Some varieties of the field beet have red stem, branches and veins of the leaves; in others the leaves are wholly red, and in others the roots are red, brown or yellow. The colored varieties are thought to be more hardy than the white. Some white varieties are cultivated in gardens for their large leaves, which are used as spinnage and in soups, especially the great white, or sweet beet, the foot-stalks and ribs of the leaves of which are stewed.

There is a sea-beet found in salt marshes. Beets require a mellow and warm soil, well pulverized to a good depth. They are sown early in squares of about 8 inches. The beet capsule, or seed vessel, contains several cells, each of which has a seed; therefore 4 or 5 plants may be produced; these should be reduced to the healthiest *one*, and those taken up may be transplanted. They are hoed 2 or 3 times. The under leaves may be broken off for swine towards fall; this admits the sun and air to the roots. These should be taken up before frosts come. The fibrous roots should not be removed nor the herbage cut close. They keep good all winter. 1,160 bushels per acre were raised in Monroe co. N. Y. last year, and some weighing 25 pounds. One weighing 42 pounds, it is said, was raised in Europe a year or two since.

The manufacture of beet sugar.—The discovery of sugar in the beet was made in Prussia in 1447. In 1800 the Institute of Paris decided that it was unwise to manufacture from it. Napoleon, by the Milan decrees of 1809 prohibited the importation of British sugar and at once sought for means to supply its place, which were found in the beet; and, in 1812, the manufacture was successfully prosecuted. But the peace of 1814 and the introduction of W. India sugar, soon destroyed the manufactories. Again, a duty on foreign sugar, which in 1829 amounted to a prohibition, revived and established 100 manufactories, producing 11 million pounds. This continued for a time, but the reduction of the duty ultimately gave the advantage to the cane sugar, and that of the beet of late has been neglected; so that only 44 manufactories are now in operation in France; and the amount of sugar produced there last year, was but half a million pounds. Beet sugar, no one doubts, can be successfully manufactured in this country, having advantages superior to any other country for the purpose, with a superabundance of soil.

The process of making beet sugar is first by cutting off the rootlets and necks, washing, rasping and pressing. The juice is put into a copper boiler and mixed with one 400th part of sulphuric acid, and lime to saturate the acid. A brisk heat is applied, when a thick greenish froth forms, and the juice, of a yellow cast, becomes clarified The scum is removed in an hour or two, and the juice let off by a step cock, a little above the bottom, and transferred to a boiler and evaporated. At a certain density animal charcoal, in the proportion

of 2 to 100 of juice is added in powder, and afterwards the froth is removed and the syrup is filtered through woolen cloth and cooled. Sulphate of lime is added in a few hours which is carefully removed before boiling for crystalization. Otherwise the process is the same as with cane sugar.

B. vulgaris. *(Red)* flowers heaped; leaflets of the calyx toothed at the base; lower leaves ovate. B. cicla (white.) Flowers in threes; spikes greenish, axillary; leaflets of calyx without teeth; leaves oblong, spear-shaped; colors various, as with 1st; subject to many varieties.

TURNIP. *Brassica rapa.* C. 15. O. 2. Br. siliquosæ. A. 1 ft. —from *to boil.* The turnip is a well known and valuable esculent and edible root, much cultivated here and in Europe. The tops and roots are eaten by sheep and the latter by horses and cattle; the milk of cows, however, is made unpleasant by eating them. Boiled or roasted, and with pepper, they are a valuable food for man. Bread has been made of them in times of scarcity by boiling them over a slow fire, squeezing them dry, mixing them with as much flour, and kneading them with yeast, salt, warm water, and then baking them. Their taste is not then perceptible. Turnips are good sea stores and the young tops are used for greens. They are raised from seeds in light soils, sown in June and are preserved stacked, or put under ground, for winter use.

The value of the turnip crop in England is estimated at $60 million; it emiatus barren soils and leaves them clean for other crops. A leg of mutton without mashed turnips is thought but half a dish. They are pulled, boiled, pressed dry, and served with butter, pepper, salt, &c. Turnips are used medicinally, for cough, hoarseness and similar complaints. The syrup extracted by baking them, when mixed with honey, is used for the same things. Middle sized turnips are best for the table as larger ones are more or less spongy. They are most useful in broths and white soups. They are nourishing though sometimes flatulent and indigestible to weak stomachs, especially in a raw state. They are preserved by keeping them, with the tops off to within an inch of the bulb, in a dry pit, or cellar, and covered with straw. 600 bushels or 20 tons is a moderate crop per acre. They are becoming the basis of a great improvement in our husbandry. 1200 bushels of 60 pounds each, were raised in Monroe co., N. Y., last year, per acre.

There are several varieties, the *common white* and *ruta-baga* being the principal. Bridgman selects 16 varieties for the garden. The varieties commonly known are the *white* and *yellow.* Of the first are the *globe* and *green-top*, with the bulb greenish, and the *blue-top*, with the bulb redish; and also the *red-top.* Of the 2d or *yellow*, are the *aberdeen*, more hardy than the globe, and the *Swedish*, or *ruta*

baga. The latter consumes a good deal of manure. These are sown about the middle of June with a drill harrow. When in the rough leaf, they are hoed and thinned to 8 or 10 inches, and afterwards the ground is small-ploughed and the weeds covered. The white, or the old English are sown about the middle of July, and managed as above. The seed plants should be placed by themselves and not exposed to the farina of others. All the degenerated Swedish turnips bear bright yellow flowers which should be pulled before the seed ripens; but the true sort have *brownish* yellow flowers. Tobacco plants, set a rod apart among turnips, are said to save them from insects, or lime strewed over them. Turnips are commonly sown here as a 2d crop, about a quart, or a pound to an acre, broad cast. Ashes and lime are strewed over the soil after sowing; say 15 bushels of the 1st and 25 of the 2d. Newly cleared or swarded land is said to produce the best turnips. For sheep and cattle, turnips are superior food. Sown broad-cast, the land should be harrowed and rolled.

The turnip prefers a lighter soil than the cabbage tribe, but it must be well manured, especially the garden turnip. The field culture has become an important part of agriculture, as it should be, from the fact we have stated under the head of the chemistry of agriculture, as to its being the most productive crop grown. The best culture is in drills, by which 25 to 30 tons are raised from the acre; even 60 tons have been raised. This plant was cultivated by the Romans and esteemed by them next in value to corn, both to man and animals, and it was thought, their mode of cultivating it was superior to that of moderns. It was, indeed, long cultivated in the east before being brought to Europe. It is a favorite vegetable in Sweden and it is much cultivated and greatly esteemed even in Lapland, where a whole cheese is given for a single turnip. It is eaten raw with avidity by the Russians, and handed around with brandy, on silver plates, among the nobility. Its size is very small in the S. of Europe, scarcely exceeding half a pound, though in ancient Rome they are said to have weighed 40 pounds. They are cultivated in India but appear to have less weight and flavor in hot than in temperate climates.

The turnip is a biennial plant, with large radical leaves. The flowering stem shoots up the second season, bearing flowers, the petals of which are in the form of a cross, and hence called *cruciform.* Field and garden varieties differ, and these differ according to soil and culture; all have, however, a globular form, with crown and top-root. The 10 varieties commonly cultivated are distinguished by differences of color, size, time of flowering, &c. The Maltese golden turnip is much esteemed for its flavor, though small. The Swedish turnip is large and more hardy than other kinds, but it is strong and coarse. The French turnip differs from others, having a root similar to that of a carrot, and highly flavored. It is widely cultivated in Europe, and

considerably here. The rind is barely scraped when cooked, as its peculiar taste resides in it. Few dinners are made without it in France and Germany. This turnip grows on almost any soil, and without manure. By sowing turnips broad-cast in spring and summer, they may be obtained during all the year. They are thinned and hoed, or left thick, so that the turnip-fly will spare sufficient for use.

Turnips often acquire great weight, even 29 pounds, and a yard in circumference, it is said. An oz. of seed is said to contain near 15,000 single seeds; each weighs, therefore, a 15,000th part of an ounce. Its growth, when uniform, increases 15 *times its weight in a minute*, and it has been proved that turnips have increased 15,990 times the weight of their seed every day! The weight and surface of turnips, in regard to soil, is also very great. An average crop yields 11,664 roots per acre; and if each average 6 pounds, the whole will be 69,994 pounds.

The rind of the common turnip should be carefully peeled off before being eaten, as it contains an acrid principle, as in mustard and the rind of radishes. Boiled or mashed in milk, turnips are a light and wholesome food, especially to the plethoric and sanguine. The composition of the turnip is chiefly water combined with nutritive matter, of which 4 or 6 parts are saccharine, 8 or 10 starch, &c. The juice, after boiling, coagulates and deposits albumen.

B. rapa; root a continuation of the stem, orbicular, flattened, fleshy; radical leaves, lyrate, rough; stem-leaves entire, smooth; stem erect, branched, round, smooth; flowers yellow; calyx yellow; pods round.

CARROT, *Daucus Carota*. C. 5.01. Umbilliferæ, sp. 8–17. Dh. Tr. 2 ft. The wild plant is a small woody root, but the cultivated carrot is large and succulent. It contains much nutriment, but it must be perfectly boiled. It is an excellent food for horses and cows in winter, with hay, causing in the latter an increase of milk; swine also thrive well on it, as it contains much saccharine matter. 10 pounds of carrots yield half a pint of strong ardent spirits, and an acre produces 240 gals. A syrup made of the roots, and clarified with the white of eggs, is useful for many domestic purposes, and the juice and an infusion of the seeds are some used for the gout, &c. For scurvy a marmalade is made of them, and they are used as a poultice for gangrenous ulcers. With a paste of flour and arsenic, crickets are effectually destroyed by it.

The carrot is supposed to have come from Candia, but the wild plant grows here and in Enrope. It is much used for soups, stews, &c., and forms a fine side dish with boiled meats; it likewise makes an excellent pudding, and in some places it is much eaten pickled. There are several varieties (Loudon reckons 10 garden varieties). The *early orange* is best for the garden, and the *long orange*, or *red*, for field crops. The *horn carrot* is a good crop for thin soil, being both early

and late. A distinguished physician says, that besides one of the most considerable culinary roots, "it strengthens and nourishes the body, and is very beneficial for consumptive persons." It has less sugar than the parsnip or beet. A fine carrot pudding is made by grating half a pound of the best carrots, and adding a pound of bread, and 6 or 8 eggs, half a pint of wine, with nutmeg and sugar to the taste. Stir the whole well, add milk if too thick, lay a puff-paste over the dish, and bake it an hour. *Carrot pies* are made like pumpkin pies, the carrots being boiled tender, skinned, and sifted.

The seeds do not retain their vegetative powers more than a year, hence they should be proved before sowing. A main crop is sowed about the 1st of April. The root requires a deep sandy loam, and affords one of the best returns. The largest have been raised in gravelly soil. They bear drought well, as they draw nourishment from considerable depth, nor is the ground much exhausted by continued crops. In gardens, and sometimes in fields, they are sown in drills or small furrows, an inch deep, 9 to 12 inches apart and across beds. The space between rows may be turned over with a narrow spade, in May and June. They should be boiled for cattle. The crop is rarely affected by insects, and seldom fails of a good yield. For the table, they need not be much thinned. The land should be twice harrowed, 1st with a long-toothed harrow. 727 bushels, exclusive of tops, have been raised in Mass. on 3-4ths of an acre, the tops weighing 5 tons.

It is certain that the carrot was well known to the ancients as an edible root, being often mentioned by their writers; and it has continued to be cultivated since in the east. All attempts to change the wild carrot into the esculent root have failed. It was introduced into England by the Flemish. The ladies in the time of James I. ornamented their heads with carrot leaves, to resemble the plumage of birds, and they are some used now for house ornaments. A section, cut in winter, from a thick sprout of the roots, and placed in a shallow vessel of water, throws off young and delicate leaves in the form of a tuft, making a fine ornament for the mantel-piece at that season.

The root, cut transversely, shows 2 parts of different texture and color, the *bark* and *wood*. The bark is most pulpy and sweet, while the heart or woody part, particularly when full-grown, is fibrous and stringy, and are seen, when separated, to be bristly, even through the rootlets. The crown, sending off the leaves, is connected with the woody part, and the outer skin of the leaves and stem is connected with the bark of the root. The latter being most nutritive, the value of the carrot depends on the relative proportion of these two parts of the root; hence it is important to obtain that part in the greatest proportion, and this depends on the mode of culture. The soil should be light, mellow, and deeply dug, so that the root will meet with no obstructions, to throw off lateral branches.

Generally, all esculent roots do not require strong soils, or those highly manured, as they thereby yield much of their strength to the herbage, at the sacrifice of the best part of the root. The seeds have numerous forked hairs, by which they adhere together; they should, therefore, be mixed and rubbed with fine sand, in the proportion of 1 bushel of sand to 5 pounds of seed; the mixture is then laid in heaps, and occasionally turned, for 2 or 3 weeks before sowing. This occasions their quicker germination withal. The seeds are sown with the sand, as that assists in their equal diffusion. The plant springs up before the annual weeds, and in 5 or 6 weeks it is hoed, which being repeated 2 or 3 times, it requires no further culture. 800 bushels have been gathered per acre; but commonly from 200 to 500 are grown. In the garden a succession of crops is obtained; they are thinned to 6 or 8 inches, and cultivated with care. They are dug in November, and preserved in winter in sand. Those intended for seed are replanted in February, 2 feet apart, the crown a few inches below the surface; they produce seed in autumn, and are a source of profit.

Some carrots have weighed 4 or 5 pounds each, and have measured 2 feet in length, and 12 or 14 inches in circumference. Cattle, after being fed on carrots, are said to prefer them to turnips, and readily fatten on them; swine are fattened in a very short time, and the flesh is white and firm. Carrots are very efficacious in restoring the wind of horses, which also retain their strength and sleekness fed alone upon them and worked. Poultry also thrive on them; and they are said to afford a good nourishment for dogs. Being highly antiseptic, they are sometimes used in surgical cases.

Some say carrots are more nutritive than turnips, but the nutritive matter is less, perhaps, in proportion to the quantity of land. 98 parts in 1000, or 10 per cent. are nutriment, of which 3 are mucilage and 95 saccharine matter, which accounts for their antiseptic qualities; and this matter, ready formed, is greater than in any of the cereal grains, and 6 times greater than that of potatoes; and, consequently, are supposed to be better for distillation, but it cannot be crystalized to form sugar. It has been said that an acre will yield for this purpose $175. 18 tons, the produce of an acre, yield 100 gals. of proof spirit, a greater amount than that yielded by an acre of barley, while the refuse will feed swine. 168 pounds of malt yield 6¾ gals. of spirits, 24 per cent. above proof, or 2 gals. per bushel; so that an acre of barley should produce 74 gals. of proof spirit, or 899, wine measure. As food for man, the carrot is light and wholesome. It increases milk in mothers eating of it freely. When eaten by invalids, the external parts, for reasons before mentioned, should be selected.

The officinal root of physicians is the common carrot (*radix dauci sativa*). Carrot juice (*rob dauci*) is reddish, and after standing, deposits a feculent matter which has lately been used in medicine. This,

at a temperature below 212, coagulates, forming a yellow substance, which is dried. The carrot seeds used in medicine are those of the wild carrot; they have a peculiar aromatic odor, while those of the cultivated carrot are much milder. The constituents of the juice, evaporated to dryness, are *fixed oil*, with some *volatile oil*, *carotin*, *unchrystalizable sugar*, with some *starch* and *malic acid*, 93.71; *albumen* 4.36, *ashes*, with *lime*, *alumina*, *iron*, &c. The volatile oil has an unpleasant taste, and but half a drachm is obtained from 34 pounds of the root. *Carotin* is a crystaline salt. The seeds are aromatic, stimulant, diuretic, and carminative. They have been employed in suppression of the urine and in dropsies, and the expressed juice as an anthelmintic. A poultice is made of the cultivated root boiled, and is used to correct fetid discharges, to allay pain, and to change the action of ill-conditioned ulcers.

The wild plant is indigenous in pastures and the borders of fields. The species recognized in botany are D. carota, *wild carrot*, or *bird's nest*. D. mauritanicus, *fine-leafed carrot*. D. visnaga, *Spanish carrot*. D. gingidium, *shining-leafed carrot*. D. muricatus, *prickly-seeded carrot*.

D. carota; leaves pinnatified, much cut, trebly winged; foot-stalks of leaves nerved beneath; stem upright, grooved, hairy; flowers white, separated; calyx-absolite; petals inversely heart-shaped. The cultivated root is a variety, but longer, softer, with a taller stem; umbel, when in seed, concave. Root of wild plant small, dry, sticky, white and starry flowered.

PARSNIP. *Pastinaca-sativa*, C. 5. O. 2. Umbelliferæ, sp. 4–6. Fr. B. 2–4 ft.—from *to feed*; a name given for its nutritive and wholesome properties. It is a native of the south of Europe; and, in its wild state, is a slender, woody, and poisonous root; but cultivated, it becomes large, succulent, and highly valuable. It is biennial, as most other sap-rooted vegetables are. It was long cultivated in the S. of Europe before its virtues were known. It abounds with saccharine juice, or sugar, excites appetite, and is excellent for convalescents. By distillation it yields an ardent spirit not unlike that of the potato. Wine is made from the roots, which approaches very near to the Malmsey of Madeira and the Canaries. This is made, too, with very little trouble or expense; and a few years only are requisite to make it agreeable and wholesome; and yet, singular as it may appear, dollars are paid for foreign wines, which may be more easily obtained for dimes.

Beside their well-known use with salt fish and meats, parsnips form an excellent side dish, when boiled and dipped in a batter of flour and butter, or the white of eggs, or fried brown. A very agreeable soup is also made of them, but they are not less valuable fried or roasted. For family use in winter and spring, they should be abundantly cultivated, being wholesome, nourishing, and profitable. For cattle and

other animals they are likewise of the first importance. Cows give more and richer milk, and their butter is of a better taste and color when fed on this root. They fatten sheep, pigs, and oxen in a short time. For ship's stores no vegetable is better. They should be boiled from 30 to 40 minutes in water seasoned with salt, or with salt pork, which is better, and then mashed and fried in butter. In parts of Ireland they are used for brewing, with hops, an agreeable beer or beverage. Their seeds are used for intermittent fevers.

There are but few varieties. The *Guernsey* parsnip is an improved variety of the common kind, and the large Dutch, or headed; it is now much cultivated. They should not be dug too early. They are kept good in dry sand under cover, or left in the ground till spring. The average crop is 24 tons to the acre. They are said to render the flesh of fattening cattle delicately white. From a species on the shores of the Mediterranean is obtained a gum which is celebrated in the East for curing all diseases. The variety with which milch cows are fed in some places is called *Coquaine;* they run 4 feet deep, but are not over 6 inches in diameter. Parsnips are sowed in drills, in March, with room to admit of stirring the soil, and then thinned to 12 inches, with the usual subsequent culture, and gathered in Oct. They are housed as carrots, or as required, they not being easily injured by frosts. No insect injures them, and they require little manure. They do not impoverish the soil, and often improve annually in quantity for 30 years on the same soil. They will continue to grow till winter. They should not be wounded, nor should the tops be taken off close. They should be kept in an out-house, not in a warm cellar. Cultivated for domestic animals, horse-hoeing husbandry is applied. They are much sown in autumn as a second crop.

But one or two varieties are generally cultivated, though there are many sub-varieties. The 3 varieties of Guernsey and French are the *Coquaine Lisbonaise* and *Siam*. The first we have noticed; the 2d is shorter, but thicker and of the same quality, with short and small leaves upon the crown. The third has not so large a root, but is more tender and of richer flavor than the others. The Guernsey is now much cultivated in the west, but it degenerates if the seed is not carefully kept from other varieties. The parsnip requires a deep, free soil; the seed is often sown broad-cast, and afterwards merely kept free from weeds. It is pulled when the leaf decays and stored in sand, or may remain in the soil through the winter without injury. In very rich soil, it acquires a rank taste, but is more abundant. A light soil, dug 18 inches deep, is best. Roasted in the ashes of peat, it is as farinaceous as the best potato, and is much used as a substitute for it. In some places, also, it is beaten up with the potato and butter, and is thus nutritive and wholesome. Its cultivation, however, has somewhat declined, for human food; since it requires the

same soil as potatoes, which are more nutritive; but it continues to be much eaten by papists with salt fish. The analysis of parsnips gives in 1000 parts, 99 nutritive matter, of which 9 are mucilage, and the remainder saccharine matter. The botanic varieties are P. Lucida, *shining leafed parsnip;* P. sativa, *common parsnip*, and P. opoponax, *rough parsnip*. This last is the species affording the gum-resin before alluded to.

Water parsnip, *sium*, a genus of aquatic plants S. nodiflorum closely resembles the water cress (nasturtium officinale) when not in flower. It is considered poisonous, though in doses of from 2 to 4 dchms. alone or with milk, it is an excellent alterative in cutaneous diseases.

P. Sativa. Stem upright, striated, rigid and branching; leaves pinnate, alternate and sheathing at the base, composed of oval, slightly lobed, incised leaflets; flower small, yellow, in umbels. S. of Europe.

RADISH, *raphanas sativus*. C. 15. Cruciferæ, sp. 5-9. Fr. A. 3 ft.—signifying *quick*, in allusion to its quick vegetation. It is supposed to have come from China; but it is universally cultivated in temperate climates, and valued for its grateful pungency and agreeable relish, when mixed with salads, or eaten raw with bread and butter, &c. It has a penetrating nitrous juice, by which it is medicinally a good anti-scorbutic. It should not be eaten to excess, as it contains little nourishment, especially in a raw state, in which it should be crispy and not tough, stringy, or over-grown. For all complaints of the chest, such as difficulty of respiration and hoarseness, the syrup is as good as that of turnips, and is said to be efficacious in the hooping cough. When boiled and served up with asparagus, radishes make an excellent dish. An agreeable pickle is also made of the seed pods, alone or mixed with other vegetables, for which use they are gathered young and pickled soon afterwards.

Radishes when young are esteemed a great luxury in our chief cities, and are much cultivated in this vicinity. For the markets, they are forced in hot-beds, like cucumbers. There are 9 or 10 varieties chiefly cultivated in the temperate climates. The turnip-rooted are best for a late crop. They are externally red, white, violet, &c., but always white within. Oil is extracted from the seeds of one variety for culinary purposes. The wild radish, R. raphanistrum, is a troublesome weed in our grain fields. It requires a deep, sandy, loamy, mellow soil. The 2 spindle-shaped and globular-rooted kinds are chiefly cultivated; and there are many sub-varieties known as *spring*, *summer*, *autumn*, and *winter* sorts, all forcing well on hot beds. R. caudatus, or true radish is remarkable for the length of its pods, which are greater than that of the whole plant.

The varieties commonly known is the *long* and *round*, or turnip radish. The usual mode of culture is to sow in drills, 6 inches apart, early in spring, and repeated every 2 or 3 weeks, to keep up the pro-

duct. *Scarlet top* is esteemed the best in England, requiring less room than those with larger tops. The *long purple* is raised for salad, and for the pods for pickling, for which it is sown in drills and cut young, like mustard and cress. The *white turnip-rooted* is crispy when young and is esteemed in spring. The black turnip-rooted spanish is large and esteemed for autumn. For early consumption the seed is sown in Feb. in hot beds and covered with mats during frosty weather. The long scarlet and the white and red turnip are sown for early crops and renewed monthly in moist soil. Some have better success with crops sown in Aug., as they are more sticky and strong in mid summer than in spring and fall. Radishes being uncertain in their growth, sowing between rows of other plants is recommended; for, being soon pulled, they do not incommode them. They require much room when raised for seed; the most thrifty are therefore transplanted. Equal quantities of buckwheat bran and fresh horse manure, mixed well in the ground, is advised to prevent the attacks of insects. The fermentation is succeeded in 48 hours by toad stools; then, if the ground be dug again and the seed sown, radishes grow rapidly and free from insects.

R. Sativus; leaves lyrate, notched, rough; stem branched; flowers purple in corymbose clusters; sepals 4, oblong, parallel, erect; petals heart-shaped; pods erect, juicy, oblong with 2 cells, pale, glaucous, tipped with an awl-shaped beak; roots varying from spindle-shaped to round, and in color from white to purplish black. China.

SKIRRET, *sium sisarum*. C. 5. O. 2. Umbilatæ. sp. 18. Fr. P. 1 ft. This is a species of the water parsnip; but it partakes of none of its poisonous qualities; it is, indeed, a very nutritious vegetable. It is a native of China, and has been known in England since 1548 and is now much cultivated there. The roots are fleshy tubers, half an inch in diameter. When washed, boiled, drained, dipped in butter, fried brown and served with melted butter &c., they form an excellent dish. They may be stewed, or when boiled, eaten cold, with oil and vinegar. It is thought to be superior to the parsnip by many. It may be raised from seeds or offsets. If raised from the former, the seeds are sown the 1st of April, and thinned out to 8 or 10 square inches. It is taken up as wanted, or when full, in Sept. Skirret was much esteemed by the Romans. It has a luscious sweetness not pleasing to the majority of people; besides, it requires a large quantity of soil. It should have a light, sandy soil, a little moist. The seeds are sown broad-cast, say an oz. over a 4 foot bed, or in shallow drills 10 inches apart, on ground well and deeply dug. The plants are thinned out to about 8 inches. The longer they remain in the ground, during open weather, the better, but, on the appearance of frost, they should be taken up, cleaned and preserved, like other roots, in sand.

The species commonly known are S. sisarum, *skirret*; S. rigidius,

virginia water parsnip; S. fulcaria, *decurrent water parsnip;* S. siculum, *Sicilian water parsnip.*

S. sisarum; leaves pinnate; upper leaves in 3's, sharply cerrate; umbels terminate; root fleshy, oblong, tuberous; stalk a foot long, terminated by an umbel of white flowers. China.

HORSE RADISH, *Cochlearia-amoracia*, C. 15. *Cruciferæ*, sp. 11. Fr. P. 3 ft. A common kitchen plant and species of the *Scurvy grass*, the roots of which are much used on the table, cut into shreds in vinegar, and accompanying meats; the herbage is also used as a winter salad and in sauces. It is a native of this country and England, and commonly found growing in ditches, marshes, or near farm houses. Before its use upon the table, it was applauded for its medicinal virtues. It stimulates the solids to activity; and, from its warming nature, is good for nervous diseases arising from cold and viscid juices. As a condiment with fish or flesh, it creates and assists digestion, and is recommended in hard dry coughs, and also on account of its penetrating qualities, for rheumatism, scurvy, palsey, dropsy, &c., used internally or externally. It may be preserved all winter, by grating the root when in perfection, and putting it in bottles filled with vinegar and corked tight; or the roots may be preserved in dry sand. An infusion of horse radish in cold milk is the best and safest cosmetic known. It is easily cultivated, being propagated by the tops, 2 inches long; and, for its virtues, merits much attention. The tops are used as greens. It is grown best by trenching the soil and putting in manure. A moist soil increases the bitter alkaline flavor of this and all the cruciferous plants. All the scurvy grasses have powerful medicinal properties, as antiscorbutic, sialagogue, and stimulating.

When grated, the root evolves a highly penetrating acid vapor, exciting a copious flow of tears; and it is very pungent. Its composition is *acrid volatile oil, bitter resin, extractive, sugar, gum, starch, woody fibre, vegetable albumen, acetic acid and acetate and sulphate of lime.* It causes vomiting when taken into the stomach in the form of an infusion, and produces vesication when applied to the skin. Chewed, it serves as an excellent masticatory. It may be used as an emetic, or to promote the operation of others, particularly in poisoning by narcotic substances. It is a general stimulant, diaphoretic, and diuretic, in small doses scraped into threads. The compound spirit is obtained by macerating and boiling the root and seeds in water for 2 hours, and straining, and then using it in small doses for chronic rheumatism, paralysis, dropsy, and scurvy.

The species are C. officinalis, *common scurvy grass;* C. glastifolia, *wood-leafed scurvy grass;* C. armoracia, *Horse radish*;—root leaves, oblong crenate; stem leaves lanceolate, gashed or entire; root perennial, spindle-shaped, long, durable, acrid; stem erect, leafy; root-leaves stalked, large, sometimes wing-cleft; flowers white, in loose panicles.

JERUSALEM ARTICHOKE, C. 19. O. 1. Dh. 5 ft. (*sea artichoke*), has a potato-shaped root, produced by a species of the sunflower (helianthus tuberosum), growing wild in S. America, and often found in our gardens. It is 8 or 10 feet high, with yellow flowers. 70 or 80 tons of the roots are grown on an acre, often times. They succeed in almost any soil, and once planted, they flourish in the same soil without much attention. They are planted in March and in Oct., and are preserved in sand during winter. The roots are eaten plainly boiled, or served up with fricassee-sauce and in other ways. They are said to be valuable for swine, and if ground, for horses.

The Cardoon, C. cardunculus, is the foreign name of this plant. It is much eaten in the S. of Europe, as a salad, pot-herb, and in stews. It is a native of Candia, and is called the *Cardoon artichoke.* The cardoon of France was introduced from thence into Canada, and called the Canadian potato. This is a variety, and is now the *Jerusalem artichoke* of our country. This name has been corrupted by the English from the Italian *girassole*—to turn with the sun. It is a native of Brazil, and is there baked in pies with marrow, dates, ginger, sack, and raisins. The roots are mostly boiled in water till tender, then peeled and stewed with butter and a little wine. They are planted and raised like the potato on a light rich soil. If earthed and covered in winter, the tender leaf stalks are fine as salads, for soups and stews.

It was introduced into England in 1167, where it was much cultivated and esteemed till potatoes came into use. Its name arises from its similarity to the artichoke. It flowers in autumn, and bears our severest winters. The root is composed of many tubers in clusters. 40 are often attached to one stem. If a small piece of tuber be left in taking them up, a plant will spring up from it. The best roots are obtained from cuttings of tubers, planted like potatoes (though earlier), which they resemble. 7 acres will yield near 400 tons, or sufficient to keep 100 swine for 6 months. Its chief recommendation is the certainty of a crop; its not requiring manure, its flourishing upon any soil, and being proof against winter weather. It has been found to yield 640 bushels to the acre, while the same land yielded but 327 bushels of potatoes. It also withstands well the dryest weather. On poor soil, it will produce at least 30 per cent. more than most esculent roots.

Leaves spiny, all wing-cleft, large, cottony beneath, upper ones decurrent; scales of calyx ovate; stem thick, cottony, a little branched; flowers blue, terminal.

ARROW ROOT—(fecula tuberis) *maranta arundinacea,* C. 1. O. 1. Cannea sp. 7–20. Eh. 2 ft. This is an important plant on account of the value of its root. Its properties resemble those of the potato. It is a native of S. America, and much cultivated in gardens in the East

and W. Indies. Its name is from the use made of it by the Indians in healing the wounds made by poisoned arrows. It is also used as a remedy for the stings of bees, the bites of insects, for burns, and for poisons. There are several species. As imported, it is a kind of starch, or hardened mucilage, obtained by pounding and blanching the roots, and is a pleasant and valuable aliment for children and invalids. When the roots are a year old, they are dug, washed, beaten to a pulp in wooden mortars, washed, and the fibres removed. The milky liquid is then passed through a seive and allowed to settle, when the water is drawn off. The white starch is again washed, settled and dried on a white cloth in the sun, and powdered, when it will keep for a long time. No vegetable except the salep or orchis-root yields so much nutriment. It is often much adulterated with flour of potatoes. The purest is the Jamaica or Bermuda. The potato starch answers as a good substitute, prepared in the same way.

It was found in the east on the shores of the rivers. The bulb is oblong, with pendulous tubers. The fecula obtained from its tubers is sold in the eastern markets. There are 2 kinds of fecula in commerce from the E. Indian root. Its fine white is distinguished from that of America. Examined with the microscope, it consists of ovate particles, not unlike the starch particles of the potato, with numerous and fine rings. Fecula, like that of arrow root, is obtained from several species of *curcuma*, and several other plants in various places. Its composition is carbon 44 and water 55. It is largely exported from the W. Indies. About 2,500 cwt. are annually taken to England. It is used at the table in the form of puddings. In irritations of the alimentary canal, of the pulmonary organs, or urinary passages, it is valuable as an emolient and demulcent. It is given to infants and invalids in water or milk with sugar, spices, or lemon juice. *Wake Robin* has been used as a substitute.

Carolla unequal, one inner segment in form of a lip; stamens petaloid, with half an anther; style-hooded; ovary 3-celled; fruit 1-seeded; stems branched; leaves ovate, lanceolate; peduncles 2-flowered.

SALEP, *orchis mascula*. Order 20 of Juss. This plant is much cultivated in Asia for the root which, in Syria, Turkey, and Persia, constitutes a large portion of the food of the inhabitants. There are many species of this genus, from which salep is prepared; that above is however much preferred, and it is from this that the article of commerce is prepared. It comes from the Levant in small, hard and yellowish white pieces. Still, the plant is found here and in Europe, and though not of so fine a quality, it should be more cultivated and improved; for it is said to contain more nutriment, in proportion to its size than any other vegetable root known. The root is composed of two fleshy lobes; and the stem is sent up from a lobe of a former

year and a new one formed, which is matured when the leaves and stalk decay. The roots are then dug, washed in warm water, and the skin removed with a brush. They are then put on a plate in an oven for ten minutes, when they become transparent; they are then spread in a room a few days. In hot water they form a thick mucilage, highly nutritive and valuable for the sick, and as an article for ship's stores.

A small quantity added to milk retards its acetous fermentation, and milk is thus kept sweet a long time. Hence, mixed with wheat in bread, it would be highly valuable. An ounce to a pound of flour is sufficient, when the bread will be much improved. Salep is very wholesome and has been much used in medical practice. It is obtained from many of the orchis tribe of plants. It is much imported and no doubt it might be made very profitable cultivated here. An oz. with 2 quarts of water forms a jelly that will support a man a whole day. It should therefore be found on board of all ships, and with travellers as affording, in emergencies, the most nutriment in the smallest space. in rich land the orchideæ do not come to maturity, but rot in the ground.

Wake Robin, arum masculatum, grows wild in woody and shady places and possesses properties not unlike those of the salep. In its wild state the plant is very acrid and the juice of the root blisters the tongue; but this noxious quality is readily dissipated by heat, as with that of cassava. It has been proposed to substitute this root for the salep and arrow root.

CASSAVA, Tapioca plant, physic nut, or mandioc. *Jatropha manihot.* C. 21. O. 8. sp. 9-21. Euphorbeaceæ. Es. 3 ft.—from *remedy* and to *eat.* The farinaceous fibres of the roots of this plant constitute its value and the object of its cultivation. The plant is a native of S. America where it formerly afforded the greatest part of the food of the indians; and it is now greatly used in Brazil and Mexico. There are nine species, two of which are cultivated for food, the *bitter* and *sweet.* The first, (J. manihot,) in its natural state, is poisonous; the 2d is innocent, but it is not so much cultivated. It is a spindle-shaped root, about 15 inches long and appears like the beet. It has a tough fibre running through it which the other has not. The bread from both of these is palatable and wholesome, and is preferred by those accustomed to it, to wheat bread. When dug, the roots are washed, the dark rind peeled off and the root ground or grated on a revolving wheel. The pulp is then placed in a bag and pressed, to extract all the deleterious juice, and then baked on a hot iron hearth, in the form of thin cakes. The cakes remain good for a long time, if kept dry. The poisonous juice of the bitter cassava is entirely expelled by the heat of baking; it is so volatile that the sun expels it, when the root is cut into pieces; so that cattle feed on it with safety. If the juice be drunk, however, violent retching en-

sues, the body swells and the animal or person dies in convulsions; but, if boiled with meat and seasoning, it forms a favorite and wholesome soup. Cassava forms the chief bread in Guiano, and parts of the W. Indies; and the juice when pressed out is used for poisoning arrows. The roots of the sweet Cassava are roasted in hot ashes and eaten without grinding, tasting like chestnuts. With butter, &c., they are delicious; both are propagated by cuttings, and in 8 months the tubers are eaten. The juice is fermented with molasses and converted into an intoxicating drink, much used by the Indians and negroes, and also in use when this continent was discovered. A starch, or *tapioca*, prepared from the roots is much exported from Brazil, and is a very wholesome and nutritive food, in puddings and for children and invalids. A new species was lately discovered in St. Domingo.

The poisonous juice of the root acts only on the nervous system, inflames the stomach and reduces it one half in size. A little mint water and salt of wormwood, timely administered, prevent all deleterious consequences. The plant thrives in any situation. It may be cultivated here by cuttings. It is thought to be identical with the Brazilian arrow root. When dried, it is called *tapioca* by the natives. Two kinds are imported, one in small lumps and the tapioca of the shops; the other is in powder. The scrapings of the fresh root are successfully applied to ill disposed ulcers. They are used to catch birds with, as they on eating it, lose the power of flying. The milk white juice, which is the narcotic poison, is said to be of the nature of prussic acid. The local application of the root is demulcent and emolient; and, as an article of dietetical importance, is light, nutritious, and very wholesome for the sick and convalescent.

Flowers monœcious; calyx 5 parted; no petals; stamens 10; style 1; stigmas 3; leaves palmate, 5 to 7 parted, smooth; segments lanceolate, entire; root thick, tuberous, flesh white; flowers axillary.

SCORZONERA, or *viper's grass*. C. 1. O. 1. *Compositæ*. sp. 19-33. Dh. 1–2 ft. *Hispanica*. This plant is greatly esteemed in Spain as a certain remedy for the bite of the viper *scurzo*; but this idea arises, it is thought, from the tortuous form of the roots; for it is a rule that all plants used as food by man possess very inactive qualities, otherwise they would be unfit for food. S. hispanica is esteemed as diuretic, stimulant and sudorific. A drink is made of it for viriola; it is also cultivated as an esculent. The root is like a carrot; the skin being scraped off, it is boiled or stewed and eaten like carrots or parsnips, and it is cultivated like them. It is a native of Spain. Its root is extremely delicate, and is a valuable addition to the table. It is not so much cultivated as formerly in England, having been banished by *fashion*; "for," says an English writer, "this tyrant which rules with universal sway, commands the taste as well as the smell, to

consider as intolerable, articles to which our ancestors had a peculiar attachment." Most fortunately, *fashion* does not prevail to that extent in this country; so the people commonly eat what they choose. The plant was introduced on account of its supposed medicinal properties; but it was found to be nutritive and palatable. It was long kept a secret by a Moor, but is now much esteemed in the S. of Europe as an edible root. It is a hardy perennial with a stem 2 or 3 ft. long, and with yellow flowers, which bloom from June to Aug. The root is thin and spindle-shaped, with a double brown skin and containing a milky juice. It is best propagated by seed, like carrots, as the offsets degenerate. The roots remain unaffected in the ground during the winter. The roots being bitter, are steeped in water before being used in any way. The lower leaves are linnear, painted and about 9 inches long. This root might be cultivated, no doubt, very advantageously in this country. It also much resembles *salsafie*, but is more delicate. Directions for the culture and cooking of one answer equally well for the other; but the seed of the scorzonera may be sown 2 weeks earlier.

TUMERIC. *Curcuma scitamineæ*. C. 1. O. 1. sp. 16-18. Dh. P. 1–5 ft. The tubers of many of the species yield a beautiful, clear starch like arrow root, which, in some places in the east, forms a large part of the diet of the people. C. longa has been much used in cooking to give color and for dying. The roots are aromatic and smell like ginger, and are imported in short pieces for seasoning; it is also considered aperient and resolvent, and has been given in jaundice. It tinges the urine a deep yellow. *Curry powder* is the form in which it is used in India and Europe. It gives a rich yellow color.

The tubers (*radix curcumæ*) are known as the *Bengal*, *China*, and *Java*; the 1st are far the best, and they are the *long* and *round*; the 1st is an inch long and an inch in diameter; the 2d is 2 inches long and colors the saliva like saffron. An acre yields near 2000 lbs. of the root. Its composition is *curcumin* 10, *yellow extractive* 11, *gum* 14, *woody fibre* 57, *water*, &c., 8, in 100 parts. The curcumine is obtained by digesting the alcoholic extract in ether and in evaporating the tincture to dryness; it is yellow and resinous. An infusion of tumeric is much used as a chemical test for the presence of free alkalies, &c. It is also used as a condiment and coloring ingredient. It has been used in jaundice and several visceral diseases. Tumeric paper is unsized paper dipped in a tincture prepared by digesting 1 part of the root in 6 of proof spirits, or a decoction in water.

This root might be cultivated to advantage in the U. S., as the profit must be large.—Corolla limbed, 2 lipped, each 3 parted; style capillary; capsule 3 celled; leaves with sheathing petioles. spike simple, erect, comose; flowers dull yellow, 3 to 5 together.

ARUM, C. 21. O. 7. Palmæ, sp. 30–45. Dh. ft. 1–6. Perennial and

herbaceous plants, mostly natives of hot climates. The roots are fleshy, hot, and acrid; but those of many species are eatable. They are generally without stems, and constitute a very singular family. The stalk of the leaves of one species are spotted like the belly of a snake. The flowers smell so strongly like carion that they can hardly be endured. They might be used in medicine and domestic economy. The roots and parts of the leaves are boiled, and the latter, when young, are often eaten raw.

A. macularum (*Wake Robin*) has a tuberous root, the size of a nutmeg, which is used as food and medicine. Their acrimony is lost in drying, and they become fit for boiling or baking. They are exported from the Isle of Portland, and sold as Portland *sago*. Medicinally they are stimulent, diaphoretic, and expectorant. The berries are devoured by birds. Dried and powdered, they are used by the French as a wash for the skin, under the name of *Cyprus powder*. 3 species are found in this country.

The juice of these plants is particularly distinguished for its acridity. That of the *Dumb Cane* of the West Indies proves fatal in two hours, if but two drachms be taken. Every part of the *Wake Robin* is acrid; but by boiling or heating, it loses this property, and the white amylaceous powder is very nutritive. A. calocasia is cultivated in Egypt for the nutritive properties obtained from the tubers, and A. esculentum is cultivated in the West Indies for the same purpose. On the Sandwich and other Pacific islands, also, this last, with the bread fruit, is the chief food of the people.

Dragon Root, *Arum triphyllum* is indigenous to the U. S., growing in damp woods, and is known here also as the *Indian turnip* and *Wake Robin*. The root is perennial, and the tubers are round and flattened. It sends up a purplish stem early in the season. At the extremity of the stem is an ovate accuminate green spathe, striped with purple, convoluted at bottom, flattened at top and bent over like a hood. The male flowers are at the summit, and the female at the base. The berries are clustered, scarlet; leaves are long, sheathing; petioles composed of 3 ovate accuminate leaflets. The plant in all its parts is extremely acrid, but this is more apparent in the roots, producing a corrosive and burning sensation in the mouth, when chewed. This acrid principle is very volatile, being driven off entirely by heat, or drying; but it is not imparted to water or alcohol. The root consists almost entirely of fecula or starch, which can be obtained from it as pure and white as that from the Arrow Root. When partially dried, it possesses highly stimulating properties, increases the secretions, and particularly those of the mucous coat of the bronchiæ. It may therefore be efficaciously used in chronic *bronchitis*. The powder is used applied to the apthæ of the mouth of children. Dose 3j. Whilst so much has been said of the nutritive properties of *Salap*, *Arrow Root*,

Cassava, &c., foreign vegetable products, we are provided with one no less valuable, and one meriting general attention and cultivation.

CYPERUS, C. 3. O. 1. Cyperaceæ, sp. 22–250. P. ft. ½–1. The roots of some species are eatable, and considered eminently aphrodisiacal, hence the name from Venus. They are marsh sedgy plants. The root of C. longus is warm, bitter and agreeably aromatic. Another species produces pea-like tubercles, which, when boiled, are eaten in parts of France and Spain, tasting like chesnuts.

CAMPUNULA, C. 5. O. 1. sp. 75–240. Dh. P. ft. ½–4. C. speculum, or Venus' looking-glass, a showy genus, and the roots of some species are eaten, and it is thought those of all may be. The long, thick roots abound with a milky juice. C. rapunculus is much cultivated in France and Italy for the roots, which, being boiled tender, are eaten hot or cold with vinegar and pepper. Other species may be cultivated for the same purpose, and for their flowers, which are much admired.

PSORALEA, C. 17. O. 4. Leguminoseæ, sp. 28-62 Es. ft. 2-6. The species are covered with little tubercles. They are chiefly low shrubs, and some are ornamental and of easy culture. *P. esculenta* is the Indian bread root of America, and is said to be cultivated in Missouri and the west, where it is used like potatoes.

WILD-LIQUORICE, *abuis*, C. 17. O. 4. Leguminoseæ, sp. 1. E. ft. 12.—from *elegant*. The roots are used in the W. Indies like those of liquorice, and the seeds are strung as beads, both for ornament and as rosaries. They are said to be deleterious, but are eaten in Egypt, though the hardest of the pulse tribe. The common liquorice will be described under the head of Medicinal Vegetables.

DENTARIA, C. 15. Cruciferæ, sp. 7-16, Tr. P. ft. 1-2. Plants with showy flowers. The dried root is said to be used in this country instead of mustard, under the name of *pepper-root*. 2 sp. N. A.

EARTH-NUT, *arachis*, C. 17. O. 4. Leg. sp. 1-2. ft. 2., anciently applied to a plant which had no stem nor leaves, but was all root; it is now applied to a plant, the fruit of which is borne under ground. The specific name, *hypogæa* (below ground), is in allusion to this curious circumstance. As the pods grow they force themselves into the earth, where they ripen their seeds! It is cultivated in the southern and northern climates. The seeds are said to be used as chocolate in S. Carolina; in the east as almonds; and in China they furnish oil used for lamps, and are a substitute for the oil of olives. It is raised in hot-beds, and transplanted. It is common about Paris. 1. sp. S. A.

EARTH-NUT, *bunium*, E. 5. O. 1. sp. 2. P. Tr. ft. 2.—growing in elevated situations. The roots of some species are dug up and eaten. They are sweet, farinacious, and nourishing. Swine are very fond of them, and fatten very soon by feeding on them.

BIND-WEED, *Convolvulus*, C. 5. O. 1. sp. 34-185. P. ft. 2-6 An extensive genus of beauty and usefulness. The C. abatatas is well known as an edible root (the sweet potato before mentioned). The stems are generally herbaceous and trailing. It is a native of America and the East Indies. It was sold as a delicacy when exported to Europe. It is cultivated in the tropical climates like the potato. The young leaves, as well as the tubers, are eaten boiled. Species are known as C. major and C. minor, and some are a common pot-herb in the East Indies. C. arvensis is a worm-like plant, difficult to eradicate in gardens, and is a certain criterion of a dry soil. C. Seammonia affords the well known gum resin of that name.

ŒNOTHERA, C. 8. O. 1. Onograriæ. sp. 32-41. Dh. 1–4 ft. The roots of the O. biennis are eaten after meals, as olives are, to induce wine-drinking. It is an ornamental genus, and is called the night primrose, from its flowers opening between 6 and 7 o'clock in the evening. The roots are eaten in the spring in some places. The herbaceous kinds of this country are among the most beautiful of plants.

TACCA. *Pinnatifida*, C. 6. O. 1. Arodideæ sp. 1 Eh. ft. 2. Has a large sized, red root which, in its natural state is extremely acrid and bitter, but these qualities are modified by culture. The raw root being rasped and washed frequently in cold water, a white meal like starch falls to the bottom. This is again washed two or three times till no acrimonious taste is perceived in the water; and all the infusions are carefully thrown away as poisonous. This meal is made into a nourishing bread by many of the Pacific islanders. It is also used in the east and preferred to the Saco bread. It is safely applied to deep wounds. The leaf stalks, boiled a long time are also used, as well as the roots, for food in China. It is exported and sold as "arrow root," as prepared at the Missionary stations in the S. Sea islands. Cakes made of the meal of the tubers are the *tacca yony*, a diet of China, Cochin China, &c.

This order of plants is imperfectly known. The roots become larger and milder by cultivation. They are analogous to the arrow-root. The fecular or starch is highly nutritious. At Tahita, Otaheita, they are scraped by strings made of the cocoa-nut tree, and the pulp being washed, is made into balls and dried in the sun and then reduced to powder. Nutall has given it the name *Tacca oceanica*.

CULADIUM. C. 21. O. 7. Aroideæ, 1 sp. 20 ft. Ds. 16–37. A species is cultivated in the W. Indies for the leaves which are boiled and eaten. It is supposed to be a species of the arum family, the most universally cultivated. It is found in America, both the Indies, the S. Sea Islands, &c. The root is very acrid, but roasted in ashes, it becomes well tasted. The leaves are used instead of plates and dishes.—2 to 8 ft. Eh.

GOLDEN THISTLE. *Scolymus.* C. 19. O. 1. sp. 3. ft. A spring plant with simple, soft and sweet roots, used for food. The leaves and stalks also abound with a milky juice, and are eaten in Spain in the same manner as cardoons. The flowers are used for adulterating the imported saffron.

CLUB-RUSH, *Scirpus,* C. 3. O. 1. Cyperaceæ, sp. 11–96. E. P. 6½ ft.—a Rush, principle food for cattle and sheep in parts of Scotland, in the spring. The bull-rush *S. Lacustris,* is used for bottoming chairs. For this use it makes the finest bottoms when a year old, and is coarser as it becomes older. For thatching and packing it is also much used. Several varieties are eaten by cattle and the roots have been ground for bread in times of scarcity. The water-chestnut of the Chinese is a species. The tuberous roots are cultivated there in tanks and are eaten boiled or raw, and are esteemed as food and medicine. The club-rush abounds in this country, in moist places.

ARROW-HEAD. *Sagataria.* C. 21. O. 7. Alismaceæ. A. sp. 6–16 ft. 1 to 2. A very handsome aquatic of this country, Europe and parts of Asia. The bulb fixes itself in the earth below the mud, and is used for food by the Chinese who cultivate it extensively.

SMILAX. C. 22. O. 6. Smilaceæ. Dc. 5–10 ft.—from a *grater;* the stems are rough with stiff prickles. S. aspera has roots not unlike those of the sarsaparilla with similar but inferior qualities; it is larger, more porous, and less compressed. S. sarsaparilla is another species of the genus (which see under head of medicinal plants.) S. China has long roots and is employed in China as food and as medicine and in the W. Indies to feed swine.

HOTTENTOT'S BREAD. C. 22. O. 6. A plant of the east the root of which is cracked and resembles the shell of a tortoise; it is a large fleshy mass, which the people use the pulp of as a sort of yam in times of scarcity.

ARRACACHA is a plant cultivated in South America for its farinaceous root. The principal root branches into several parts, each of which is often over a foot in length. It grows at an elevation, near Bagota, of 8,700 feet, corresponding nearly with our latitude, and hence it is believed that it may be successfully cultivated in the U. S. The product must be abundant; and we are surprised that no greater efforts are made by the friends of agriculture to introduce this and similar exotics. It is highly nutritive and palatable, and is being introduced into England.

YAM, *dioscorea sativa.* This plant is supposed to be a native of the E. Indies, and transplanted to the W. Indies. It grows spontaneously in Ceylon and some other places, and is extensively cultivated in Asia, Africa, and America, for its valuable tuberous root, which is eaten roasted and boiled; and like our flour, is made into bread, puddings, &c. It much resembles the potato in its farinaceous qualities,

and is considerably exported. It is a climbing plant, with tender stalks, about 20 feet long. The root has singular horns; is about a foot in breadth, of a dark color externally, but white within.

The winged yam (*dioscorea-alata*), is a species much cultivated, with roots 3 feet long and often weighing 30 pounds. The species are cultivated like the potato; are planted in Aug. and dug in Nov. Having apparently no buds, and sending out stems from any parts of the surface, a portion of the skin is left on each piece planted. When dug, the roots are dried in the sun, and placed in dry sand or casks.

The yam is esteemed little inferior to the potato either in flavor or nutriment. It is easy of digestion and palatable. The juice, like that of many of the most valuable roots, before being boiled, is acrid and irritating to the skin. The roots of some varieties are twisted like serpents, or spread out like the hand and fingers. They arrive at maturity sooner than the potato, but are raised in a similar manner. Care is taken that they be not wounded when dug. 30,000 pounds have been raised on an acre.

The species are all vines, with heart-shaped leaves and small flowers. One of these is common in our southern and middle states. No doubt they might be cultivated here to great advantage.

LEGUMINOUS PLANTS.

This useful class of vegetables affords the 2d division of the farinaceous seeds, those of the cerealia constituting the first. Next to these and the potato, they are the most important esculent vegetable in this and most countries of Europe and Asia, both for man and the lower animals. They are found in the tropical climate, even on dry and otherwise unproductive soil. Their nutritive parts, or seeds, are within 2 valved, oblong pods.

Carbonic acid is said to be more abundant where these plants are cultivated especially during their flowering, and that miners are made fatally sensible of it. Those of this family of plants, not applicable for human food, are much eaten by domestic animals; and they are not only thus useful to the animal creation, but, by attracting moisture from the atmosphere, they greatly aid in the growth of other plants, the seeds of which are sown with them. They are therefore grown together by the Hindoos, to be more certain of a crop of small grain; and, in the event of a drought, of a pulse crop. The tops, from this circumstance, are observed to be fresh and green when the bottoms are dead. The properties of the legumes are exceedingly variable. Similar organs of species closely allied are often found to elaborate very dissimilar principles, and the diatetical, medicinal or poisonous properties therefore vary in a corresponding manner. Of all the species of this genus the well known *pea* and *bean* are most valuable.

The flower of the leguminous plants, on maceration in water, exhibit an *alkali*, which is an evidence that they contain nitrogen, an element of animal matter; while that of the cerealia, under like circumstances, always exhibits an *acid*.

PEA. *Pisum sativum*, (corrupted by the English from *pisum—to bruise*, in allusion to the grinding of the legumes by the ancients, or from the town *Pisa* where they grew—into *peason*, or *peas*. C. 17. O. 4. Leguminoseæ. sp. 4. Dh. A. 1–6 ft. The botanical species of this plant are P. sativum, *common pea;* P. arvense, *field* or *green pea;* P. Maritimum *sea pea;* P. ochrus, *yellow-flowered pea*. The garden varieties of the pea are very numerous; those commonly cultivated constitute the most valuable of the culinary legumes. The tendrils spring from the terminations of the compound leaves, and none of the species are without them for their support.

Green peas are the most agreeable and nourishing of prepared fruits. They are raised in large quantities in this country and much eaten without injurious effects. If somewhat flatulent, that quality may be corrected by the use of mint. They are excellent, as commonly said, in sweetening the blood and correcting scorbutic humors. During their seasons our markets are well supplied with them. Some 20 or 30 varieties are cultivated. These grow to different heights according to soil, season and kinds. It is quite an object therefore to obtain early peas and hence much attention is paid to their cultivation near this and all our large markets.

They should be cooked, when fresh and young, immediately after they are shelled. The water is first seasoned with salt and boiled; the peas are then put in, with a bunch of spearmint and the cover eased, so as to let off the steam. They are boiled about 25 minutes, according to their ages, &c.; but they should be tried, to ensure their being done to a nicety. They are then drained and prepared with butter, spices, &c. Sugar-peas, having no tough skins within the pod, are boiled without shelling, and served up like the kidney beans.

To keep green peas for winter use, fill a stew-pan with those which are young and green, put in two or three table spoonfuls of sugar, place the pan over a brisk charcoal fire a few moments, stir them 2 or 3 times, and as they yield their water pour them on a dish to drain; which done spread them on a paper out of the sun and turn them frequently. They should be perfectly dried or they will mould when put away. French beans may be prepared in the same way, and they will keep till the next season as good as when gathered. It is said also that they may be kept by putting them into bottles and corking them perfectly tight; or, after bottling, submitting them to heat 1½ hours; this is the French mode. They should be used as soon as they are taken out. Young peas are thus much better for soup than when ripe.

For the best pea-soup take a knuckle of veal and boil ½ of an hour; boil 3 pints of peas till soft; strain, mash and rub them through a sieve. Mix the pulp with the water the veal was boiled in; put the whole in a stew-pan with good lettuce, some powdered mint, pepper, salt, &c., and stew moderately till the lettuce is well done; then serve them up with thin toasted bread and a little ginger. Of the sugar pea is made a favorite dish.—Take the young pea in the pod, stripping off the outside edges only; put them in a stew pan with good gravy, thickened with flour and butter, a little mace, ginger and nutmeg; stew gently till the pods are quite tender, then serve up as a side dish. These two dishes are superior to any other of this vegetable.

New varieties of the pea are frequently noticed, but few become popular. The garden and field pea are different. The flour of the latter is often mixed with that of wheat by bakers. Alone it is heavy and unwholesome, but with three parts of rye flour, they make a palatable and nourishing bread. Dried and split in a mill, peas are much used in soups; and, when burnt like coffee, they are considerably used as a substitute. Much of that sold as ground coffee is ground peas. By raising in hot beds and transplanting, peas are had the 1st of May, and by raising and maturing in pits they are had in April; but the pea does not force well. Stiff or sandy loam land, that has been limed or marled, always produces the best peas, whatever the variety may be. The straw of the pea, cut and dried, is as nourishing as hay and an excellent fodder for sheep. Pea flour is as 3 to 2 of the bulk in grain, in nourishment, and when husked and split, as 4 to 20. The flour affords in a 1000 parts 574 or 57¼ per cent of nutritive or soluble matter, of which 501 is mucilage, or vegeto-animal matter, 22 sugar, 35 gluten and 16 insoluble extract. On open ground the pea is sown from Jan. to the middle of July.

The pea is indigenous to the south of Europe, and was well known to the Romans, who probably introduced it into England. Of the many varieties the 2, P. sativum, or garden pea, and P. arvense, or field pea, are generally cultivated. It is sometimes cultivated with the bean, for, since the use of drill husbandry, the bean has been much more cultivated than formerly. It attaches itself to the bean so as to admit of being hoed and exposes its roots to the air, by which its growth is promoted.

The pea is greatly used as sea provision, and also in hospitals and workhouses. In Great Britain more than half a million of people live on peas and beans. In addition to her product, which must be very great, there were imported in 1831–476,480 bushels of peas, and 187,104 bushels of beans, the greater part of which came from the north of Europe, mostly from Russia, Germany, and Denmark. And the exports from Calcutta were over 1,300 tons. The pea is much used in India as the most light and nutritive article of food in travelling, and

they are sold in the shops as bread is in this country. It is the sole business of many in Egypt and Syria to fry peas for those who cross the deserts. It is cultivated in China and most parts of the east.

The *white*, *yellow*, and *grey* are the chief varieties of the common pea, and the sub-varieties are innumerable. The colors are also much intermixed. The white and yellow are the garden and field peas, the first of which is the choicest, and is raised for eating green, while the latter is allowed to mature. The names of the sub-varieties can hardly be preserved, being arbitrary and derived from the names of persons and slight circumstances. All may be distinguished by some differences of tenderness; but, if attention be paid to soil, situation, culture and time of sowing, most varieties will afford good crops. The garden varieties are chiefly *early* and *late*. The first are more slender and less productive, but are more hardy; and others admit of being forced, to afford the best luxury of early summer. The latter having the full influence of the sun to mature, are large, more productive, and they contain more saccharine matter; thus, as with many vegetable products, they are cheapest when most nutritive, and within the means of all.

The period of vegetation is short, two crops being sometimes raised within the season. The earliest crops are obtained by sowing the seeds in a dry soil, last of Oct. In favorable situations and seasons, they sustain the winter, and may be gathered about the first of April. But they are a precarious crop, and do not always pay the cultivator; they are therefore brought forward in hot-beds, when the demand and price justify.

Of the field varieties, the dark sorts are longest in maturing, and their flavor is rankest. If sown in favorable places in autumn, and cleared as soon as ripe, they may be succeeded the same year by a crop of turnips. Peas are believed to improve the soil, particularly for turnips and wheat. The rows should run north and south, and the early crops should be sticked. The soil for early crops should have been manured the year before, and should be light, dry and sheltered. Fresh manure causes peas to run to herbage. The soil of late crops, sown from March to July, should be moister and of more consistency. The addition of marl, lime, or road-stuff is important.

The mode much practiced in the early cultivation, is to sow crossways on warm borders or ridges, 2 feet broad at the base. Drills are drawn 1½ inches deep near the bottom; the seeds being sown, are carefully covered when observed to break ground. When sown last of November, soot, mixed with slacked lime is strewn over the rows, or finely sifted coal ashes, to prevent the attacks of insects. A light stirring of the soil is a preventive. When a few inches high, they are staked thick on the most sunny side, and a foot higher, but not too near, the pea.

Different varieties require different distances at which peas should be sown. 3 feet apart for those not over 3 feet high, and 4 and 5 for those over that, is thought the best average distance between the rows; but some dwarf kinds need not be over 2. Nothing is gained by sowing too thick. A pint of seed for early small kinds is sufficient for a row of 20 yards, and for main crops, this will sow a row of 33 yards. Peas grown without sticks require least room. 3 peas within an inch of each other, of the frame; 2 of the hotspur and dwarf marrow-fat; 3 in 2 inches of the Prussian blue and middle sorts, and larger sorts 1½ inches, and Patagonian, 2 inches apart, are good distances. But field peas are not usually sown thick enough, for when thick they support one another. 3 bushels are sown on an acre, and 20 are the average product. One row only of high peas is advised—leaving within, a bed of 12 feet for onions or carrots. Some sow peas between hills of potatoes, and find them very productive; 3 peas in each hill after the potatoes are planted.

Two earthings are necessary for peas that are to have sticks; the 1st when 4 inches high, and the 2d when 6 or 8. If a succession of peas is required, they are sown more or less every 3 or 4 weeks from Feb. to July. If the weather be dry, the drills are to be soaked with water, and the peas also during the night previous. Lines of strings, a foot apart, are often run along and attached to each stake, and the tendrils entwined by hand around them. Stakes and strings thus allow little place for birds to light to destroy the pea, and also a free circulation of air. Mice are said to be kept from peas and beans by sowing the tops of furze, cut fine, in the drills. Soaking the peas a day or two in train oil is better.

For forcing, the mode is like that of beans. They may be sown in pots or pans, placed in a frame, under glass, and transplanted in frames or pits, 2 or 3 inches apart. Early dwarfs are best for this. But fall-sowing is thought preferable. The soil should be very dry for these, and they should be protected from frosts by straw or brush-wood. Some top the leading sprouts when in blossom, to hasten the sitting and maturity of the fruit.

Knight's marrow pea is thought best for late crops, sown at intervals of 10 days. A new variety has lately been brought from Cuba to Charleston, S. C., by Dr. Strobel, which is said to be of a very superior quality, yielding in Spain 300 bushels to the acre, and selling in Havannah for $1.00 to $1.50 per bushel. *Bishop's early dwarf prolific pea*, 12 or 14 inches high, is spoken of as one of the best varieties.

The finest plants of a variety should be preserved for seed. Peas are often sown broad-cast, but the row culture is the best, sown 2 ft. or so apart, and 6 inches deep in light, and 4 in clay soil. By sowing peas 10th of June, the pea-bug has been effectually avoided. This bug, or fly, lays its eggs or larvæ when the plant is young, and when

furnished with wings, it appears, perforates the pod and diminishes the fruit nearly a half. Buggy peas scalded half a minute, then cooled and sown immediately, destroys the bug and hastens the growth of the fruit. The bugs do not infest peas on new settlements, if not carried and planted in the pea. Peas degenerate faster than most plants, and should be had for seed from more northern places; they should be changed once in 2 or 3 years; and when cut with a sickle, should be spread to dry, and not stirred till carefully taken to the barn. After thrashing, they should be spread on the floor to be aired 2 weeks, and then put into casks. For mildew, water applied copiously once a week, is recommended.

Peas steam-boiled, or when ground, fatten swine well; and the flour is greatly used for human food, mixed with the flour of the grains, particularly rye, as bread, for soups, and in various ways.

P. Sativum; foot-stalks cylindrical; stem branched, leafy, smooth; leaves alternate, pinnate, eliptical, opposite leaflets ending in climbing tendrils; stipules in pairs; flowers white, inodorous; seeds 5 to 9; many varieties.

CHICK PEA, *Cicer-arietinum*, C. 22. O. 4. sp. 19. This plant belongs to the same class, order and family as the common pea and bean. It is a small legume much cultivated in the S. of Europe as a dying ingredient, and as an article of food. It was the parched pulse which constituted the common food of the Hebrews in the field. It is called on the coast of the Mediterranean, *garavance*. The seeds are not eaten alone; for, unlike most other pulse, they do not form a pulp by boiling. They are commonly used as a garnish strewed over viands; and in Spain they form the favorite dish, *olla*, composed of bacon, cabbage, pumpkin, &c. Parched, they have been greatly esteemed from a very early period, and they are still much eaten in Europe and Asia. They were a common food of the lower orders of Rome. What was before said as to the use of peas as food in crossing the desert, applies especially to this species.

In Nubia the seeds of a small pulse, called *Kerkedan*, grows wild, and is much eaten, made into a kind of bread, and as a substitute for coffee.

Another plant of the kind, called *symka*, and indigenous to that country, produces seeds resembling the pea, and affords a valuable food for the camel; and when green, for man. An oil is also obtained from it, by boiling, which is used by the natives, as they use butter, for oiling their hair and bodies.

Numerous other small legumes are cultivated in the East, like the grains. Rains being very unfrequent, the legumes are necessarily much cultivated there, as the pulse sustain dryness better than the cerealia, by their absorption of atmospheric vapor. The smaller and more hardy these are, the more certain are they of affording a crop.

LYTHYRUS is a genus of the leguminous plants, containing 19 species. To this genus belong the *Sweet Pea*, so frequent and ornamental, the perennial *Everlasting Pea*, *Earth Pea*, *Anson's Pea*, &c. L. Sativa, or *Chickling vetch*, and L. pratensis, or Meadow vetchling, are cultivated in Europe as fodder.

The genus *Pterocarpus*, of a Red Saunders, which is the well known tree, affording the fine coloring wood of commerce, is in this class and order, as its fruit is in pods. Many other plants belong also here, but are mentioned under other heads, or do not merit particular notice.

BEAN, *Vicia faba*. C. 22. O. 4. Leguminoseæ. sp. 38–100. Dc. A. 2–6 ft.—A native of Egypt, and probably introduced by the Romans into Europe. The seeds, the parts mostly used, are a wholesome aliment and are much eaten here in their dried as well as green state. There are 12 varieties cultivated. As an accompaniment for a boiled dinner, the *garden bean* is excellent, served with butter, gravy and spices and a bunch of green parsley. 30 or 40 minutes are required for boiling. With fat pork or bacon, they are a dainty dish. They should be gathered when soft for the table, and hard for seed or baking. To bake the *white beans*, put them in water and hang them over the fire during the night, rinse them in the morning, put them in a kettle with half sliced pork, cover them with hot water for an hour, put in pepper, &c., and place them in the oven for three or four hours.—A pound of pork to a quart of beans. *String beans* should be eaten with caution in hot weather; and dried beans are flatulent. The latter are exported in large quantities from the middle and eastern states and are used as ship-stores.

There are several varieties of the *field bean*; but the fine and small ones are the best. *Bean flour* is nutritive; it is much used for bread, especially with wheat flour, with which it is said dealers often mix it. Beans are often roasted as a substitute for coffee. Roman ladies used bean flour as a cosmetic. If injured, beans may be cut down to the ground, during their flowering, and they will grow again and bear a new crop and be made, it is supposed, perennial.

The *pole*, or *running beans* are the large white, or *Carolina Lima*. A quart are required for 100 hills: a quart of the small pole beans plant 300 hills. The *kidney bean* should not be tough, when gathered, and the *strings* should all be stripped off; soak them in salted water for a time, then put them in boiling water, and in 15 or 20 minutes take them up, drain and serve them with gravy and melted butter. This bean is in the highest repute. It was brought from the Netherlands in 1509. There are 11 varieties of it cultivated, 8 of the *dwarf* and 3 of the *running* kinds. A favorite dish, called *haricot*, is made of the former by putting them into a stew-pan, after being boiled for a short time, with strong gravy and high seasoning. The former

should not be minced as is customary, but a small part of the sides being peeled off, they are cut into 4 pieces and boiled. Some dress them with onions, oil, vinegar, pepper, &c.

For working horses beans are an excellent food, and also for fattening swine. We have shown that beans are more nutritive than oats, though less easy of digestion, a bushel yielding 14 pounds more flour than one of oats, and a bushel of peas 18 pounds more. A 1000 parts of bean flour yield 570 pounds of nutritive matter, of which 426 are mucilage, or starch, 103 gluten, and 41 insoluble extract. A variety or two grow in meadows and are considered a valuable herbage plant, yielding a great bulk of very nutritive fodder. The summer and winter *tare* or *vetch*, is also a valuable agricultural plant for its herbage, especially for milch cows and working stock.

The species of the bean recognized in botany are 16, the *common names* of which are, the pea vetch, the great wood vetch, common wood vetch, cassubian vetch, tufted vetch, sanfoin vetch, biennial vetch, officinal vetch, two-flowered vetch, common vetch or tare, broad podded vetch, common bush vetch, broad-leaved vetch, narbonne vetch, saw-leafed vetch, and *common garden bean.*

The latter, like the pea, is now known to be extensively cultivated in most parts of the world. It is said to be found growing wild in Persia. Stewed with oil and garlic, beans constitute a chief food with the people of Barbary. In Ireland, they are much eaten by laborers, bruised and mixed with mashed potatoes. They are exported from G. B. in large quantities to the W. Indies for the food of the negroes. In 1840, 514,864 bushels were imported beside the vast quantity produced there.

Although a coarser plant than the pea, it is even more liable to disease and insects. Small fungi also infest the plant, especially the *sphæria nidula*, upon the roots and the blight, *uredo fabæ*, upon the stems and leaves; of which we have spoken under that head. The black *aphis* also preys upon the young leaves, and should be timely removed, or its ravages will be great.

Like the pea, the bean is divided into the *field* and *garden* varieties, though both are often indiscriminately cultivated. The *kidney bean (Phaseolus vulgaris,)* is the general name by which the common dwarf bean is called on account of its resemblance in shape to the kidneys. It is also called the *French bean*, it being a native there, as is supposed, and having been introduced from thence into other European countries.

The other species is called the *runner* (Phaseolus *multiflorus*) and is a native of S. America. This has been greatly esteemed for its ornamental flowers; and, in England, it is said to have been thus esteemed solely on that account for more than 100 years before the value of its legumes, as an edible substance, was known. The general

character of both species is similar, but *runners* rise to considerable height if supported by their tendrils. These tendrils are remarkable for their habit of always turning to the right in a direction contrary to the apparent course of the sun, and contrary to the habit of other plants. This circumstance has been attributed to the supposition that its native place is south of the equator, and that, in northern latitudes, it turns in the direction it would turn if in its native climate; that is, towards the sun.

The dwarf varieties were introduced into England against much prejudice, but they are now found equal in flavor and tenderness to others, while they are more productive and hardy. Numerous varieties have been introduced within the last 50 years, and among these are the dwarf varieties of the kidney. These are the *large* and *small*. The latter are best for forcing and are generally planted for the first and last crops, as they come quickly in and go quickly off. Of these are the *dun-colored*, *red-speckled*, *black* and *purple speckled*, *yellow* or *cream colored*. The 3d and 4th are probably the best. They are also known here as *English dwarfs*, *early mazagan*, *sword long pod*, *green nonpariel*, *Broad Windsor*, &c.

The running varieties, or *pole beans*, are the *scarlet*; from the color of its blossoms, the *white Dutch*, and *Azonian kidney*. The 2d and 3d are most esteemed. The latter is small and flat, producing pods 6 or 8 inches long in clusters of 4 to 6 on each joint from the ground to 20 feet high. The *zebra* and *painted lady* are sorts some cultivated.

The soil for early dwarf kidneys should be rich, light and dry, and manured for a crop or two before. It being well wrought and leveled, drills are drawn 2 inches deep; and, for a chief crop, at 2 or 2½ feet distance, and the seeds are planted 2 or 3 inches apart, about the 1st of May. Subsequent culture requires the ground to be kept clear from weeds. When the first rough leaves are expanded, the earth is drawn around them.

For successive crops a few rows are sown every 3 weeks, from May to Aug. The last crop is often what the English call the *negro variety*, which continues to Oct. The seed and drills may be soaked with water, as with the pea. The *Canterbury* and *Battersea*, if sown in May, come in earlier than the main crop; and by peculiar culture, like that of the pea, they may be obtained still earlier.

The culture of the running varieties is easy and simple, which may be made to form a fine arbor or natural porch to a dwelling, by running on a frame or strings. When planted in drills, like other kinds, or little farther distant, they are hoed when 3 or 4 inches high, and rough stakes are put down, or strings are used; after which they are hoed 2 or 3 times. The scarlet bean requires a more bushy pole than other kinds. If cut down and the roots are covered with litter, it will produce an early and good crop the following summer; and it may be

taken up and preserved in dry mould during the winter and replanted in April.

A new method of planting the pole bean has been recommended, which is to put the pole down and plant the beans in 2 or 3 circles a few inches apart around the pole; thus they bear more and protect one another.

A main crop may be sown about the 1st of June. Beans are so prolific that the returns from 3 sowings in May, June and July will last till Oct. They are gathered for the table when fleshy and brittle. Plants last longer and bear better to gather clean from each stem, leaving none to grow old. The beans saved for seed should be of the 1st crop and left till fully matured; then cut, laid in the sun to dry, shelled, bagged and housed. They are wet and rolled in plaster before being planted. Some say they should not be hoed when the dew is on, or in wet weather. 5 beans are enough for a hill.

Buel prepared an acre of light ground with 8 loads of long manure —ploughed and harrowed it immediately; furrowed it with a light plough, at 2½ feet distance, scattered the beans along the furrows, at the rate of a bushel to the acre; passed a double moulded plough between the rows, followed by a roller, and cleaned the crop twice of weeds; and the product was 48 bushels. Some plant between potatoes and then transplant. Some object to topping.

Artificial culture brings the bean to hand easier than most culinary plants, and for this purpose the pine stove is resorted to. The green pods are mostly used in this country, while in parts of Europe, the ripe seeds called *haricots* are cooked in various ways. The seeds of the Dutch runners are large and excellent, and are made chiefly into soups. The leaves are also much used as food in some places, when boiled. A small black bean (*fricollis*) is much cultivated in Mexico. In Africa there are 4 kinds much eaten. The bean affords much of the food of the Roman Catholics during Lent, in various shapes. Sliced and stewed in milk, beans are a common dish in Flanders.

The garden bean is often called the *horse-bean.* The Windsor bean is however raised in its stead, which may be planted in stiff, moist soil, a pint for a row of 80 feet; the rows 3 feet apart, 2 inches deep, and 4 inches distant in the row.

The tops of high beans are cut off to accelerate their podding. when the first blossoms begin to drop. If done sooner, a fresh shoot will put forth. The pods then rapidly increase, and the harvest is advanced two weeks. The nourishment which before went to the top, afterwards, it is said, contributes to the production of the fruit, as with the potato, pea, &c. This should not be done before the plant has produced all its pods. With small early beans this is done when the blossoms at the bottom of the stalk begin to open.

The *field white bean* is thought to be the only one that can be culti-

vated on a large scale in this country. But the China bean, with a red eye, is preferred by Buel. Beans are generally worth about $1 per bushel, and with care may be as profitable as wheat. The additional sorts of *kidney dwarfs* or *string* beans are, Early Cranberry, Early Mohawk (very hardy), Early Yellow (6 weeks), Early Canadian Dwarf, Early Dwarf Cluster, Quaker, China Dwarf, Large White Kidney do., White and Red Cranberry do., Warrington or Marrow, Refugee, Rob Roy, White Cutlas of Carolina. *Of the Pole, or Running beans* are Large White Lima, Carolina, or Saba, Scarlet and White Dutch Runners, Red and White Cranberry, (3 last String Beans) Asparagus, Dutch Knife, &c.

Beans may be preserved throughout the winter by removing the strings and breaking them up when green, as usual for cooking; put them in layers in a stone pot, and sprinkle salt upon them, covering and pressing them with a board and a stone upon it. They then make their own brine, and are as good in mid-winter or spring as in their season, if soaked over night, &c.

SACRED BEAN, *nelumbium*, C. 13. O. 6. *Nimphæceæ*, sp. 2. A. called in Ceylon, *nelumbo*. It is considered a sacred plant in Japan and the East, and pleasing to the Deities. The long stalks are eaten as pot-herbs. It grows in muddy marshes, and is cultivated in the gardens of the Chinese mandarins as *Lien wha*. Both seeds and roots are esculent, sapid and wholesome. The seeds, with slices of the roots, kernels of apricots and walnuts and alternate layers of ice, are served up to the most distinguished persons at table. The roots are also laid up in winter in salt and vinegar. The seeds are of the size and form of the almond, but of a still more delicate taste. The ponds in China are generally covered with it, exhibiting a very beautiful appearance, the flowers being both handsome and fragrant. It sustains the cold well, and might probably be cultivated here. There are many varieties. The Egyptians are supposed to have prepared their *colocasia* from the root of this plant, but it is not now found in that country; from which it is inferred that they cultivated it with great care. The Romans also made many efforts to cultivate it, as well as moderns in Europe. They should be grown in a tub or pot partly full of water all the time the plants are growing. The seed will keep 40 years, and flower the first year. 1. sp. N. A.

DOLICHOS, C. 17. O. 4., a plant of the ancients, supposed to be the kidney bean of the moderns. It is a climbing species, many running to the top of the highest trees in the East. Most of them are eatable, though inferior to the kidney bean. Some have tuberous roots also, which are eaten. The seeds of D. *soja* are used in soups in Japan, and are the most common dish there, being eaten 3 times a day, frequently. The *Kiljap* of the Chinese is prepared from the seeds, and is used in almost all their dishes, instead of the common salt.

They make a favorite dish of the seeds, called *Tau hu*, which resembles curd, and which, though insipid, is made agreeable and wholesome by seasoning.

CYTISUS, Leguminosæ, C. 17. O. 4. sp. 24-41. E. & Da. ft. 2-30. A genus of ornamental trees and shrubs of which some species are much admired. The true Laburnum, the false *ebony* of the French, is often sown in plantations, the twigs of which hares and rabits are extremely fond. The timber has been sold for $2 or $3 per foot. It is often planted as a fence to the sugar plantations in the W. Indies, and it thrives on barren soil. The seed is much eaten by the poor and negroes, and is considered a wholesome pulse. By some it is preferred to the pea. It is mostly used for feeding pigeons, but is given, with the branches and leaves, to feed and fatten hogs, horses and cattle. It should be cultivated here.

VETCH, (*vicia sativa*) belonging to the class and order of the common bean. This is commonly known as a small species of bean growing wild in dry meadows and corn fields. They are cultivated in England, but little here. The pods are usually in pairs; leaves winged, with about 6 pairs of leaflets, and branched tendril at the extremity. They are chiefly useful as an agricultural plant, for feeding horses and cattle. They are grown early, to allow for sowing turnips the same year; but are often ploughed in, when the soil is to receive a wheat crop. The seeds are very grateful to pigeons. *Tares* are of the same species.

V. Eroilia is cultivated in parts of Europe for the above purposes, but is inferior. The others of the 16 species are little cultivated. The *Horse bean*, now much cultivated, has 2 or 3 varieties, one of which is the Tick bean, a low plant and good bearer, much used in England, says a British writer, "for horses and fattening cattle, and formerly much bought up at Bristol for the Guinea ships as food for *the negroes in their passage from Africa to the West Indies.*"

CAROB TREE, *Ceratonia*, C. 23. O. 2., a Leguminous evergreen, and called *St. John's bread*, as St. John is said to have fed on the long pods, containing a sweet fecula, for which they are now imported. It is the locust tree of scripture. The seeds are eaten in Spain, where the tree is common.

ALLIACEOUS PLANTS.

These consist of *bulbous-rooted* plants, belonging to the natural order of *Asphodeleæ*. The bulbs grow upwards from the crown of the roots, instead of downwards, as with the tuberous roots we have described. They are not, therefore, strictly speaking, *roots*, but *buds*, destined for the protection of the embryo of the future plant, as will be seen by reference to our article on buds and bulbs. They comprise

plants greatly esteemed and eaten; but they are not very nourishing, though possessed of pungent qualities highly grateful to a large class of people, especially in the S. of Europe. But their nature will be recognized by mentioning the names of the chief kinds, which are the *Onion, Leek, Garlic, Chive, Shallot, Racombole,* &c. Of this class, and in fact, of any other class, no vegetable products are more general than these. Their bulbous roots are chiefly eaten. Their peculiar pungent and stimulating flavor is owing to a white volatile oil; they contain also much phosphoric acid, but their unpleasant odor has prevented their use as generally as their wholesome properties merit.

GARLIC. *Alium Sativum,* C. 6. O. 1. Asphodeleæ. sp. 76-107. Br. B. ½-3 ft. This is an extensive tribe of bulbous rooted plants, extensively grown in this country and the S. of Europe, where they have less acrimony. They are used for seasoning, flavoring, pickles, and in numerous ways as food. Great quantities are consumed by the poorer classes in France, Spain, Italy and Portugal. Jews are said to eat them to excess. They are esteemed as strengthening to the stomach. They are little used here by native citizens. Their smell pervades the whole plant, and in this respect, they differ some from the onion. When bruized and applied to the skin, they cause inflammation, and sometimes a blister. The juice is said to form a strong cement for glass and china, leaving no mark.

The sauce of garlic is made by peeling and dividing the cloves, boiling them in 3 changes of water and afterwards putting them in a dripping pan an hour before use. There is but one variety cultivated. They are divisible into parts called *cloves.* The most important species of this genus will be found under the head of onions, leeks, shallot, &c.

The species recognized in botany are, *great rounded Garlic;* A Porrum, *common Leek; linear leafed Garlic; long rooted; hairy; Homer's Molly,* or *Sorcerers; oblique-leafed; tartarian; rose-colored;* A. sativum, *cultivated garlic;* Scorodoprasum, *Rocambole; small round headed; purple headed; small flowered; sulphur-colored; pale-flowered; panicled;* A. ascalonicum, *eschalotte,* or *shalotte; narcissus-leafed; Canadian; Ramson; three cornered; yellow,* or *molly;* A. Fistulosum, *Welsh onion;* A. Schænoprasum, *chives,* or *chives garlic;* A. Sibiricum, *Siberian Garlic; Bastard Garlic.*

All of these species are cultivated; some for their bulbous roots and others for pot-herbs. We shall notice a few only which are chiefly cultivated in this country. A. cepa, or the common onion is the most important A. porrum has an imperfect bulb and cylindrical scale, is blanched in gardens and much used in soups and stews. A. sativum has bulbs used in seasoning and in medicine. It is propagated by dividing the bulb. A. sarodoprasum has bulbs like garlic, and is cultivated like it and for the same purpose, though it has a

more delicate flavor. A. scolonicum, or shallot, is the mildest of cultivated Aliums. It is propagated by the *clove* planted in the spring.

Garlics differ from onions chiefly on account of their greater pungency. The leaves are grass-like and not fistulous, as with the onion. It acquires its fulness, in the middle states, about the last of Aug. It forms an excellent expectorant and is otherwise like the onion, valuable in many diseases. Snails, worms, and the larvæ of insects, as well as moles and other vermine are driven away by placing preparations of the garlic or onion in their paths, or upon vegetables. Their virtues are extracted by spirits of wine. Their composition is *acrid, volatile oil, extractive, gum, woody fibre, albumen, water, starch, sulphur* and *saccharine matter*. Their ashes contain alkaline and earthy salts. The oil of garlics has a very acrid taste, strong smell and yellow color. It is heavier than water. 20 pounds of the garlic yield 6 drachms of the oil. With oxide of iron it strikes a black color; it is a powerful irritant. The Hindoos prepare a stimulating oil from it which they give internally for the ague and apply externally for palsy and rheumatism.

Garlics when eaten, operate as a tonic and stimulant to the stomach, and they impart their well known odor to the secretions. Their volatile oil becomes absorbed, quickens the circulation, occasions thirst and is thrown off by the excretories, the activity of which it promotes. Eaten in large quantities, they occasion nausea, vomiting and purging; and the expressed juice has proved fatal. They are used as a stimulant in enfeebled digestion, as a diuretic in atonic dropsies, in chronic catarrhs and as an anthelmintic. Externally it is a resolvent in indolent tumors; a local irritant, or rubefacient applied to the feet to cause a revulsion from the head or chest; an antispasmodic as a liniment—made of oil and garlic juice—in infantile convulsions; a remedy for ear ache or deafness—a clove wrapped in muslin, or a few drops of juice being introduced into the ear. It is taken internally as a bolus or in pills. A dose of the fresh bulbs is 1 or 2 drachms; or the expressed juice, mixed with sugar, or the infusion of garlic may be employed. Its use, and even its smell, is said to be valuable in the cure of vapors and other nervous diseases of females, in spasmodic asthmas, for a languid circulation, catarrhs, &c.

The *syrupus alli* of the shops is, 6 oz. of fresh garlic, a pint of distilled vinegar and 2 pounds of sugar—macerate the garlic in the vinegar in a glass vessel 4 days, express the liquor, and set it by to subside. Add the sugar to this clear liquor and use the syrup as stated. Onions are substituted for garlics and they answer the above purposes, (which see) except that they are not so efficient, or strong.

The cultivation is on rich dry soil, not recently manured. It being very hardy, it is not particular as to climate. It is propagated by the cloves planted in march and pulled in Aug. The wild garlic of Rus-

sia is much esteemed, and is preserved in winter and eaten, steeped in water and mixed with cabbage, onions, &c. as a ragout, cold. It is there a specific against the scurvy. The *sand, crow* and *leek garlics* are found wild. They are planted singly in beds, in rows, lengthwise, 6 or 8 inches apart and 2 or 3 deep. When ripe the leaves change to yellow, and they are then taken up. The stalky part of the leaves is left on the root; they are spread in the sun to dry and then tied in bunches and housed.

A. Sativum; bulb a compound of 12 or 15 cloves invested with a white skin; stamens 3-pointed; leaves linnear, long, narrow; flowers white. Sicily.

ONION, (Garlic) allium cepa. C. 6. O. 1. Asphodeleæ. sp. 76–107. Br. B. 2–3 ft. This is a species of a genus of strongly scented bulbous plants called *garlic*. The varieties are innumerable, and new ones are constantly presented. There are above 20 varieties recommended for garden culture. It is a biennial, with long tubulated leaves, a pithy stalk, swelling in the middle and a large round head of flowers, expanding the 2d summer after sowing. The root or bulb, is formed of concentric coats, which vary according to soil and culture. The small bulbs of this genus, as a general rule, are proportionably less pungent; and those of a red color are more so than the white. Those also with the outer rind or tunic thin and transparent, are always the mildest. The tops are used as a pot-herb, salad and pickle.

This plant is one of the most important flavoring substances; it has been cultivated in this country since its first settlement and was known and cultivated in Africa at a very remote period. In Egypt it was known and much esteemed 2000 years before Christ; and it is still a favorite article of food there. Its qualities are such there that it may not be thought remarkable that the Israelites lamented its loss after leaving Egypt. It appears indeed to have been worshipped in Egypt. An onion taken from the hand of an Egyptian mummy, at least 2000 years old, vegetated on planting it.

Its taste differs in different countries, being soft and mild in some warm climates and in northern latitudes coarse and hard. A soup made of it in the first named places, is very rich. Those too, of the S. of Europe, are much superior to the onions cultivated here; yet it is an article of great importance in this country, both of consumption and export, chiefly to the W. Indies.

Boiled, chopped and stewed in a pan for 15 minutes, with a little milk, butter, salt and pepper, and served upon the table hot, they are a very fine dish. The water should be changed when half boiled and salt added to the second water, poured hot upon them. Meats smothered with stewed onions are much admired. They are eaten raw, sliced in vinegar, with salt, pepper, &c.; but they thus taint the breath, while boiled ones do not.

The name *onion* is from *unio*, the Latin signifying that the bulb or cloves are united. It has been much subject to the caprice of fashion and medical criticism; still it has continued to be a common, and perhaps the most important seasoning herb for meats from the earliest periods. No flavoring substance is now more in use in cooking. It imparts a savory, fragrant and delicious taste to every culinary preparation in which it is used; it also affords considerable nutriment, and possesses important medical properties. The laboring classes in every country are especially fond of the onion; and the quantities they consume, both of this and other species of the garlic, are very great; although, in northern climates, it is not easily digested, but remains oftentimes a day or two in the stomach. It is eaten raw, but most commonly in this country, boiled and served up with white sauce or melted butter. The scent of onions is removed by eating a few raw leaves of parsley, and their digestion is thus assisted; vinegar does the same. The water should be changed when onions are about half boiled, the second water being in a boiling state from a tea-kettle. This greatly improves their quality. Fried onions are not more easily digested than raw ones, and neither are much eaten except by gross feeders. They should be chopped fine when used for stuffing geese, ducks, or any other meats, in connection with sage, &c. When chopped, they are boiled for 6 or 8 minutes, put into a cullender to drain, then pressed till no water remains, mixed with chopped sage, &c. Roasted onions are less wholesome than fried ones; and, as with these, should be eaten sparingly by those with weak stomachs.

The onion flourishes well in southern parts of New England, and is there greatly cultivated and exported. Mellow, sandy, and somewhat moist soil or gravelly loam, is preferred, requiring, as they do, much heat and considerable moisture. Soot and yard manure is recommended near the surface. Ashes are also spread over them after sowing, if the soil is not very sandy. They impoverish the soil but little, if any; and they often continue to improve upon it, with manure. The ground is dug or ploughed thinly in autumn, made fine and the seed sown the last of April. They are commonly sown in beds, 4 rows of holes in each, 10 inches apart, and 10 holes in the rows. 5 or 6 seeds, if good, are placed in a hole, and covered an inch deep. They also grow quite as well in drill-rows, a foot apart. Or, make the drills 8 or 10 inches apart, and drop the seeds at the intersecting angles. By the use of the drill-plough in field culture, half the labor may be saved. A better mode is probably that pursued in England. The ground being dug and levelled, manure in a rotted state is spread upon it, and the seed is sown on this and covered thinly by earth from the alleys, and a roller passed over it. Crops are very productive this way. In fields they are sown broad-cast, and thinned gradually for use, out of the 1st crop; the 2d remaining for planting out in spring.

These are withdrawn some weeks before the autumn crop. Small onions produce very fine and large ones, and yield offsets, but the larger ones produce the largest clusters. Care should be taken in selecting seeds, as all weeds or poor stock are pernicious. To be drawn young, 2 oz. is required for a bed 4 feet by 24; but for bulbing 1 oz. suffices. 625 bushels have been raised on the acre in Mass. Earthing up is objectionable.

Middle sized onions are better for eating than larger ones. They are hoed 3 or 4 times till the tops arrive at their height; the weeds are afterwards pulled by hand. Trampling the soil between the rows and withdrawing the soil from the bulbs, to expose them to the sun, is recommended. When the greenness of the stalks are gone from the tops, they are pulled; for after this the roots decay. When pulled they lie on the ground for 10 or 12 days to dry and harden, if the weather be fair, and then placed on a floor in a dry covered place. Scallions should not be mixed with good onions, but hung up in bunches. A warm and moist cellar is not so good as a cool and dry place, or dry casks in garrets or lofts.

When shipped, they are strung on a wisp of straw. If they begin to sprout, which injures them for eating, the fibrous roots are sometimes seared with a hot iron; the pores are thus stopped, which, admitting the air, causes them to rot. The seeds are obtained by planting early in beds, 9 inches apart; the largest and soundest are best. The tops appear in a month, each with several stems. They are kept free from weeds, and when the flower-heads are about to appear, the stems are secured to a stake about 4 feet long. Onions for pickling are grown on poor soil to keep them small. When gathered, the seeds are spread in the sun a day, to dry, and then put up in papers.

Every plant living longer than a year, generates the sap to elaborate the leaves and roots of the succeeding spring. This juice, deposited in the bulbous roots of the onion, varies in quantity according to the circumstances of the plants. It acquires a larger quantity in the south than in the north, having there more sun and heat. To effect the same here, the seed may be sown in spring, thickly, in the shade and on a poor soil, so that in autumn the bulbs are not larger than a pea. These are taken up and preserved during the winter and planted in spring, when they produce bulbs very superior to those raised directly from seeds; they often exceed 5 inches in diameter, and are otherwise better. In Portugal they are sown in Nov., on a moderately hot bed, protected from frosts, and transplanted to a rich soil in April.

The medical properties of the onion were known to the ancients. Raw onions are taken as an expectorant for winter cough. Roasted onions are employed as an emolient poultice to supurating tumors and to the ear, to relieve pain. The expressed juice is given to children and others, with sugar, &c., as an expectorant in coughs; vinegar or

lemon juice is often added. It is excellent rubbed upon the flesh for any irritation, and especially for blotches, bites, or stings of insects, which are quickly removed. Applied to the soles of the feet for several hours, or during the night, in cases of colds or local inflammations, they are found very valuable. It is said that they may be successfully used for the bites of poisonous serpents, or the mad dog, and that in sickness, in contagious diseases, they imbibe much of the contagious matter. In all cases it is used freshly cut or sliced. Placed within tainted or putrefying poultry or other meats, they are said to render them pure and sweet. They are said to promote the growth of hair by being rubbed on bald heads. Indeed, it has been suggested that the physiological effects of the onion have not been fully tested. Onions are composed of an *acrid volatile oil, uncrystalizable sugar, gum, woody fibre, albumen, acetic and phosphoric acids, phosphate and citrate of lime,* and *water.* By boiling, the volatile oil of onions is dissipated, and they are deprived of their irritating qualities.

The varieties are the Strasburg onion, which is much cultivated, but the *silver-skinned* is superior, or milder. Of the 2 sorts, *white* and *brown,* the latter keep the longest. The *white Spanish, Portugal,* or *Lisbon* onion are good kinds, but the seed is imported every 2 or 3 years. *Tripoli,* is a fine and large onion for a late crop. The *Strasburg* and *blood-red* keep well and are hardy, but strongly flavored.

The Welsh onion, alium fistulosum, is the hardiest plant, but is very strongly flavored. It does not form a bulb. It is occasionally raised for a spring crop; the seed is sown in July or in autumn, and pulled in spring. It dies early in winter, and revives in spring. It is a perennial, and all others are biennial. *Scallion* is the name of a long-necked onion producing abundant leaves, but no bulb. The *potato,* or *ground* onion is a curious variety. It is raised from the offsets of the bulb planted in the winter, and produces no seed; it is hardy, productive and mild, and its roots are ripened for use 2 months before any other sort, and resists insects better. It is earthed up like the potato, and pulled in summer.

The *Tree* or *Bulb-bearing onion; allium sepa;* Var. *viviparum,* is a singular variety, from Canada, produced, probably, by climate. Its stem is two feet high, bearing flowers which are succeeded by *no capsule,* or seed-vessel. The bulbs are grown on the top of the stalk, which falling to the ground, put out roots and vegetate. But this variety is more curious than useful. It is stronger for seasoning than other kinds. The *large Portuguese* onions are imported and sold in shops at a high price. It is a delicious vegetable, boiled, and is pulpy.

A cepa; scape swelling out below, longer than the hollow columnar leaves; flowers white.

CHIVES, or *cives, allium schœnoprasum.* C. 6 O. 1. & species

of the garlic and the smallest and finest of the genus. It is a hardy perennial and native of Siberia. It grows in tufts and is propagated by offsets from the roots. Its use is in soups and for spring salads, for which the leaves or stalks are cut close. It is cultivated as a substitute for the onion, and being mild, it is esteemed for omelets, &c. It is not drawn to eat entire; for though placed with bulbous roots, it affords none for consumption, but the thin stems are eaten when a few inches high, as a salad and seasoning ingredient. Once planted, it continues for 4 or 5 years without injury from the cold of winter. The roots are planted a few inches apart, when they soon grow into large bunches. It is found wild, but is not changed by cultivation. The bulbs are very small and connected in elongated clusters. The stalks are seldom allowed to run to seed, and when cut, others shoot up in succession. Their flavor suffers if kept after picking. The flowers are white with a purplish tinge, and appear in June. They are a fine ornament along the paths of gardens. They partake of the flavor of both the onion and leek.

LEEK, *Allium porrum*. This is a species of the garlic, before noticed. It is said to be a native of Switzerland; but was probably cultivated with the onion by the ancient Egyptians; and it is still a constant attendant at the tables there. It has long been a favorite badge as well as food of the Welch, and is now so used on St. David's day, in commemoration of a victory obtained over the Saxons in the 6th century and attributed to the leeks they wore by order of St. David. Its growth is recommended in northern countries on account of its hardy and pungent character. It requires more boiling than the other species of garlics; it taints the breath offensively, unless reduced to a pulp; but this, or any other vegetable odor, is not unwholesome, if not the effects of putrefaction. Its bulb is formed of the bottoms of the leaves, but these are not composed of cloves, as with other species. The stem is 3 feet high and the bell-shaped flowers appear in large close balls in May. The blanched ends of the leaves are used as a pot-herb, though the roots and much of the leaves are eaten in some places, with bread, &c. It is a forward and succulent vegetable in cold climates, when other fresh ones are not to be obtained. It is raised from seed and cultivated like the onion. The soil is light, dry and rich, and the situation open, with a dry sub-soil. It is dug in the fall and the crop sown the last of April. The plants are weeded and thinned when 3 or 4 inches high, and are often transplanted when 6 or 8 inches high. The long weak tops are trimmed and planted in rows 10 or 12 inches apart. The best are removed in spring to a sunny place for seed, and supported by stakes till ripe in Sep. Cut and tie the heads and hang them under cover, and when dry, rub out the seed. An ounce of seed is sown on a bed 4 feet by 8, patted down and raked lightly over.

The varieties are the *Flanders*, or narrow-leafed; the *Scotch, flag*, or *Musselburg* and the *broad-leafed, tall*, or *London* leek. They are not suited with rank soil. A small crop may be sown thinly with onions. In dry weather they require watering and hoeing several times. The whole plant is used in soups and stews, but the blanched stem is mostly esteemed. They are said to be superior when taken up the middle of July, the roots cut off to an inch in length, planted in trenches, like celery, 5 inches apart, though but half as deep or wide. The trenches are manured and the plants hoed as they grow, like celery. The leeks thus grow 18 inches under ground, and are very thick. 3 of these planted for seed are generally sufficient.

A. Porrum;—umbel globular; stamens 3-pointed; petals with rough keel; root coated; leaves sometimes very narrow; spatha short, conical, deciduous; flowers purplish, close, in a large ball, on purple peduncles.

SHALLOT, or Eshalote, *allium uscalonicum*—from *Ascalon*, Syria, and hence the name *scallion*. C. 6. O. 1. Br. P. ft. A species of the garlic, with a small bulbous root; brought from Syria in 1548, some say by the crusaders. It has a strong but pleasant smell and is preferred to onions in seasoning soups, gravies, hashes &c. It is also used as a pickle, particularly in the E. Indies, and is the best seasoning for beef-steaks. It is propagated by planting the bulbs, or cloves, which increase greatly by offsets, like the true garlic. These are not large, but grow into clusters. The soil should be a light, rich, sandy loam, or dry soil, well manured the year before. The separated offsets are planted in very shallow drills, 6 inches apart, early in March, or in Oct., or Nov., attaining their growth the following summer. Too much moisture is apt to rot the roots before they vegetate. They are slightly covered with earth. Soot, mixed with the surface soil prevents the depredations of insects upon the plant. They are then carefully weeded by hand or by hoeing. The leaves decay in Aug., when the bulb has its growth. These are then taken up, dried in the sun and placed in a dry loft, in casks, boxes, or tied in bundles. Planting on the surface is recommended to avoid the worm—raising the soil on each side to support the root, with a rich soil beneath. This edge soil is afterwards removed and the roots watered, being mostly out of ground.

The growth resembles that of the onion, but the form of the bulb remains different. The above mode greatly improves the quality and size. The shallots, if wanted, may be taken up of good size in June or July. The shallot seldom flowers, but the want of seeds is compensated by the multiplication of the roots. It bears the severest winters. Its flavor is more pungent than that of the garlic, but not so rank.

Stem naked; columnar leaves all-shaped, umbels globular; spatha

membranous; petals of corolla, erect, ovate, blue, with dark keel; bulbs oblong.

ROCAMBOLE, *allium scorodoprasum.* C. 6. O. 1. Br. P. 2 ft. A species of the garlic, and a native of the N. of Europe. It is distinguished for its mild and fine flavor. It has narrow flat leaves, with a keel or ridge on the under side. The head is contorted, but untwists on maturity, and presents a cluster of small bulbules of a purplish tinge. It is propagated by the cloves from the root, or the top of the stalk, which are larger, but less pungent. The plant holds an intermediate space between the garlic and shallot. The bulbs are smaller than those of the garlic; they are heart-shaped; and those, both of the top and bottom are used for the same purposes, but the former are more delicate. They are also planted in the same way, in Oct. or Nov. The richer the ground, the more cloves are produced.

The composition of the edible alliaceous plants we have just concluded is nearly alike in the various species and varieties, as stated under *garlic* and *onion.* Their volatile oil, constituting their acrid and stimulating qualities, being dissipated by cooking, they form a mild and easily disgestible food.

CRUCIFEROUS PLANTS.

These are a class of plants which do not afford the nutritive principle *sugar, farina,* or *starch;* but they are, nevertheless, important articles of food. It is certain that the human system requires a proportion of herbaceous vegetable matter to preserve health, and that none supply this in a more efficient form than this order of plants. These differ from most others in containing more *nitrogen,* a well known and essential element of animals; and it is further remarkable that all plants of this order are innocent if not always nutritive. Although they do not possess the principles above-mentioned, it is probable that, in the process of assimilation they are quite as important as those which do, especially in furnishing the body with the important element nitrogen.

This order of plants embraces the Cabbage and its numerous varieties of Brocoli, Cauliflower, Sprouts, &c.; also the Turnip, Sea-kail, Radish, Cress, Mustard, &c., some of which we have arranged under the general head of esculent roots, salads, &c. The plants of this order derive their nutritive properties from their mucilaginous, saccharine and extractive matter; and, with one or two doubtful exceptions, no cruciferous plants are poisonous. In most varieties of the braccia, or cabbage tribe, the parts used are the leaves. They are composed chiefly of water, with small portions of acids or salts. 90 per cent. of these are given off by drying. The remaining parts in the 100 are

nitrogen 3-7, extractive 2-34, with fractions of gum, resin, albumen and green fecula. Cauliflower differs a little from this analysis. It has been estimated that the mean time of chimification or digestion of *raw* cabbage with vinegar is 2 hours, do. *boiled* 4 hours and 30 minutes.

The Umbelliferous plants, to which belong the Carrot, Parsnip, Celery, &c., it may be here remarked, are possessed of very opposite qualities. They are always injurious, and often fatally poisonous. But the poisonous principle of these, being contained chiefly in a volatile oil elaborated mostly in the leaves, is readily given off by heat in boiling. The fruit or seeds, is thus generally preserved by peculiar chemical and provident changes, from deleterious principles. We have seen also that the juices of the principal esculent roots are deleterious or highly poisonous, but that this quality is easily removed by heat; so that cooking by fire renders them innocent, if not nutritive, by dissipating the dangerous properties; while it leaves the nutritive ones greatly improved by the process. We cannot be too forcibly impressed with the importance of this wise and beneficent provision in the laws of nature.

BRASSICA.

This class comprehends the cabbage species with their numerous varieties, belonging to the large family of *Cruciferæ*. Some of these have been cultivated from very early periods, but the varieties have been much improved, being greatly disposed to run into numerous diversities of form and character. They are eaten in a great variety of ways; and the roots, leaves, stems and buds are consumed, both cooked and raw; the seeds of some are also valuable for their oil. None of these cruciferous esculents are poisonous. They contain a portion of nitrogen, which is readily detected in the leaves; hence the unpleasant smell when they undergo decomposition, and also of the water in which cabbages have been boiled. The family of the cruciferæ contains also many weeds, and are consequently frequently changing; even those which are cultivated are crossed by the polen of the wild plants. The Romans introduced some of the species into Germany and England, and the cabbage, to this day, is a general and favorite vegetable with the German people. Very many and improved varieties have, at comparatively recent dates, been introduced. Parts of Scotland, where the cabbage was early cultivated, are now called *the land of kale.*

The species Oleracea contain the principal cultivated varieties and sub-varieties. All of these are reduced to three classes; viz: 1st, *Cabbages;* 2d, *Kale*, or *Colewort;* and 3d, *Cauliflowers* and *Brocoli.*

CABBAGE, *Brassica-oleracea*, C. 15. Cruciferæ, sp. 12-34. Eh. and B. 2 ft.—from *to devour* or *boil.* A well known edible plant derived

from a stock growing wild on the sea-coast, and from which is also the *colewort*, *borecale*, *cauliflower*, and *brocoli*. The effects of cultivation on this plant are thus remarkable. In the wild state the leaves are spreading, but in the cultivated plant they lie like the scales of a bulb. The cabbage is greatly cultivated in this country and most parts of Europe, for the food of man and beast, and is one of the most important plants in use. It has been cultivated from remote antiquity, and was introduced into Europe by the Romans. The Saxons named the month *February*, *Sprout Kale*, from this plant.

The seed is sown in April, and the plants are transplanted in rows. Boiled with meats, they are a common dish; and also cut fine with salt, spices, and vinegar, as a salad. The Germans make of them, pickled, a favorite dish called "*sour-crout*."

"*Sauerkraut*" is an excellent preparation of the Germans. It is prepared with close-headed white cabbage cut in shreds and placed in 4-inch layers in a cask. The first layer being put in, is strewed with salt, unground pepper, and a small portion of salad and oil; it is then trodden down by a person having on wooden shoes. Another layer is then put in and managed in the same way, and so on till the cask is full. The whole is then heavily pressed, and allowed to ferment for a time, after which the casks are headed up and stored away for use. The preparation of this is a distinct profession, and is performed chiefly by the Tyrolese. The shredding is performed by machines carried on the back from house to house; so that every German family stores up one or more barrels of this food. Oct. and Nov. are the busy months in this art, and "huge white pyramids of cabbages are seen crowding the markets; while in every court and yard into which an accidental peep is obtained, all is bustle and activity in the concocting of this national food; and the baskets filled with the shreded cabbage resemble mountains of green-tinged froth or sylabub." This sour-crout has been much used in the English navy, both as food and as a preventive against scurvy. The method of cooking this is simply to stew it in its own liquor with bacon, pork, or other meats; aromatic seeds and other carminatives are often added. It is not suitable for those with an acrid stomach. Its effects are somewhat laxative on the bowels.

Cabbage, though much used for feeding cattle, is said to give an unpleasant flavor to the flesh and milk of cows. But the removal of the lower leaves, most disposed to putrefaction, is said to be a remedy for these effects. The crops of this article in England appear to be greater than ours, 36 tons being an average crop per acre on dry soil; but on sandy soil the crop is not over 18 tons. A cabbage, it is said, was produced in Devonshire, a year or two since, measuring 5 feet in circumference, weighing 60 pounds, and occupying a space of 15 feet of ground.

Cabbages are sown one year, produce seed the next, and die the next. The roots, stems and leaves are dressed and eaten in numerous ways. 4 or 5 varieties only are cultivated. One of the best of these is the *Early York*, brought from Flanders. The cabbage is easily cultivated, and produces all the year. Being sown in spring, summer and autumn, a constant supply is afforded.

The Cow Cabbage (var. *arborenscens*) has lately come into use, and is the best in use for cattle. 60 plants are said to afford food sufficient for a cow for 3 or 4 years without fresh planting. Thus a square of 60 feet will contain 256 plants, 4 feet apart, and furnishes food more than sufficient for 4 cows. It is cultivated in England. The leaves of the head, by their own compression, are effectually blanched, and the green color is more completely destroyed than the red. The more blue or purple the leaves, the more sweet and crisp they are. The various modes of cooking are well known. After stripping off the outside leaves they are usually boiled in salted water, taking care to skim the water and not to confine the steam within the boiling vessel. In France they are boiled from 10 to 20 minutes, or until the fork enters the stem, easily; then drained, cut up and bathed with gravy.

An oz. of seed will produce 4000 plants. The soil should be light, moist, not very rich, and rather clayey. When sown in autumn, say 15th Sept., they are transplanted in Oct., or in Spring. They are picked out of the bed in which they are sown, when they have one or two leaves, one or two inches broad, and afterwards transplanted into rich or manured soil. They are hoed when two or three inches high. *Battersea* is a fine oval headed cabbage, but the *Nonpariel*, a recent variety, is probably the best cultivated, coming in early and heading quickly; it is delicate and good sized. *Brompton*, early Salsbury, late Savoy, early Dwarf, flat and red Dutch are also valuable varieties. The *white* and *red* are the usual distinctions here. The dwarf, Savoy, Cauliflower, and Dutch are also sorts well known.

The large Scotch is said to be the best field plant. Plants should be 2 feet apart, or greater in the field, and planted early in May. When the sun is very hot, 2 shingles on the north and south side are made to shelter them. A worm often travels from plant to plant during the night, eating off the stems and burying itself in the ground at day break. Lime or rockweed scattered around the plant is useful, or the worm may be found at the root of the stem last destroyed. Brine, soap-suds, salt water, or smoke of sulphur, tobacco, or straw is used for the lice found on the plant. A belt of hemp seed sown around the ground keeps away the caterpillar. The top and stem, dipped in muddy water, is good against drought.

The under leaves of the cabbage, may be stripped off without injury and given to cattle, for which they are very good, but not for milch cows. The plant is much fed to cattle in winter, in England

and it is said to fatten them sooner than turnips. To preserve cabbages, they are taken up on a dry day, the heads turned downwards for a few hours, to remove any water between the leaves; then set in a ridge, or bed of dry earth to their heads, in a sheltered, dry place, having removed all loose leaves. A low temporary shed made of boards, or straw on poles, is placed over them, with the ends closed with straw in severe weather. The heads may then be cut off as wanted; and if frozen, soaked in water a few hours before cooking. The best are removed to a distance for seed. They are transplanted in moist weather and watered frequently. When the heads begin to form, the stems should be earthed up. When the plants come up too thick they are thinned; 3 oz. of seed to a square perch is best. The early heading kinds are set 2½ and the late sorts 3 feet apart. 32 tons 2 cwt. have been raised on an acre in Mass. The stalks, after the heads are cut off, should be preserved for spring greens, by trimming off the long roots, laying the stumps in rows 4 or 5 inches out of ground, in a sloping direction, in a warm dry place; cover them with straw, or stalks, in severe weather; and when frosts cease, hoe them, or they may remain if protected. If not thus preserved, pull them, when cut, for the compost heap, that they may not exhaust the soil.

Cabbage means the *head;* and it is thus said, the cole has cabbaged; the lettuce has cabbaged, or the tailor has cabbaged; meaning in this case that parts of the cloth have been rolled up and packed away like the head leaves of the cabbage.

CAULIFLOWER, var. *botrytis*, the most delicate vegetable of the cabbage tribe and greatly improved by cultivation. It is supposed to be distinct from the cabbage. It has not been made to approach the cabbage in form. It was called *cole florie*, from *caulis*, a stalk, and *florea*, to flourish; *chou-fleur*, or cabbage flower is the French name. There are 2 varieties, *early* and *late*, or *white* and *red*. They do not resist our winter without aid. The seed is sown last of Aug., the plants pricked out and preserved in winter, planted in spring, and perfected from May to Aug. For summer crop, seed is sown in March and plants set out in May, and for autumn crop it is sown in April, set out in July and is perfected in Oct. A bed of light, rich earth, well prepared, may be sown, the seed raked in, or a 4th of an inch of light mould sifted over it;. Water and weed the plants occasionally. They are a delicious winter vegetable; and are gathered whilst the pulp is close. They are cooked and cultivated in a manner similar to that of cabbage. The plant attains great perfection in Cyprus. It has improved by culture in England and is there much more cultivated and esteemed than here. Dr. Johnson said "Of all flowers, I like the *cauliflower* best." The head of the plant may be preserved for months, but loose leaves become putrescent.

BROCOLI is considered a sub-variety of the cauliflower which is

constantly running into new varieties. Thus, like many other plants, having been often changed, it continues the more readily to admit of others. The *red* and *purple* Brocoli, only, were known a few years since in Italy; but there are now 13 varieties raised in England. Improvements in the culture of Brocoli, have been more rapid than those in the culture of any other plant. A hard white variety has lately been produced, both handsomer and more delicate than the green or red, and it is afforded throughout the year. A fresh, loamy soil, is required for Brocoli, and the seeds are thinly sown on beds of rich mould, and covered with mats or litter till the plants are up. The heads are a rich, seedy pulp, the white much resembling the cauliflower. The purple is generally cultivated here. In the southern states, they will stand in open ground, but they require more care in the northern. Sudden transitions from cold to heat, as with most other vegetables, is worse than continued cold. Brocoli is mostly for spring and winter use, and is served up like most other varieties of the cabbage. With the cauliflower, it is one of the greatest luxuries of the garden. Grange's early Cauliflower, Brocoli and late Tartarian Dwarf, are the two best varieties. The seeds of all the sorts are sown in open ground in rich loamy soil, in April, May and June, in rows, 2½ feet apart and 2 feet distant in the rows, watered and hoed. They are transplanted and sheltered like other species.

BORECOLE, var. *Sabellica*, is the curly-leafed colewort, and is found mostly in English gardens. The Scotch kale is the green borecole; this, with the brown and purple are the most hardy. The plants grow vigorously in rich soil, and become very large but the middle-sized are the best, the larger being harsh and the stinted bitter. This has many sub-varieties, all hardy and continuing green throughout the winter. 6 only, of these are cultivated. The tall green, or Scotch kale is best, the Russian kale is the most hardy, and the 1000 headed cabbage grows to the height of 4 or 5 feet, throwing off numerous branches, and is chiefly extolled as an agricultural plant. All the varieties are cultivated by seed, like the others we have described. The dwarf, curled, or finely fringed, is cultivated here and in Europe, for the table; it is grown in trenches on gravelly soil, and covered in winter.

RAPE, *Brassica napus*. C. 15. Eh. B. 2. ft. A plant of the cabbage tribe, growing wild and cultivated in this country as a small salad in summer and winter, like mustard and cress. The seeds are substituted for those of mustard, and with millet for bird-seed. It is much cultivated for winter greens and salad. Oil is obtained from the seed by pressure. which is used in large quantities by clothiers, in medicines, in making green soap, or burning in lamps, &c. The roots are eaten like those of turnips. It is commonly sown in July, for winter use, and transplanted. When frost-bitten, it is good and tender.

Rape is chiefly valuable as an agricultural plant for feeding cattle. The *cole seed*, as it has been called, when sown for this purpose, is sown the middle of June. The ground is prepared like that for turnips. The quantity sown is from 6 to 8 pounds the acre. The plants are hoed like turnips 2 or 3 times, being however nearer together. It is recommended to keep them for scarcity in winter, when there is no other green food. If the stalks are left in the ground, they will shoot out again early in spring and produce a crop in April, which may be fed off or run to seed. The plant withstands the winter, and affords a bite for sheep and cattle when nothing else is green. The curled colewort, or Siberian borecole is preferred.

Rape fattens sheep, as if by magic, and comes in timely between tares and turnips. In drilling, the ground should have manure. It is biennial, and seeds the 2d year. Plants intended for seed, should not be eaten down. A fair crop of seed is 35 bushels per acre. It is cut with the sickle, laid in rows and then thrashed, taking care to lose no seed. The seeds are spread thinly on the barn floor and often turned; the herbage is excellent for cattle.

Rape and cole seed are different varieties of a plant, with yellow flowers growing on ditch-banks and amongst corn. It is distinguished from others of the tribe by its root being a continuation of the stem. When the cole and rape seed are sown together, the 1st is known by its being higher, more soft and less branched. The rape commonly stands for seed and the cole for cattle. The *cake*, after the oil is expressed from rape seed, is well known for its value in fattening cattle. The roots are often eaten like turnips, and the stalks are used for fodder, fences, or are burned for their ashes.

SAVOY, *Sabauda* (wrinkled)—from *Savoy*, a district near Italy, where this variety of the cabbage was first cultivated. The general properties of this are the same as those of other varieties of the tribe. It should always be a little frost-bitten and not hard before used. The sub-varieties cultivated are but 3, the Large Green, Dwarf Green, and Yellow. Its culture is also like that of other varieties. It is a very useful vegetable and should be generally cultivated. 3 or 4 sowings are advised for a succession. It is sometimes planted between beans or peas, &c.

MILAN CABBAGE, the *choux de Milan* of the French. This is a variety much cultivated about Milan, growing tall, and producing an open, central and delicate head, with numerous equally fine sprouts. It is cultivated like the green kail, but requires more room.

BRUSSELS SPROUTS, a variety of the *Savoy* cabbage. There is but one variety which is in much repute as a dish for the table. It is much cultivated in Flanders. The stem is 3 feet high, with many shoots having heads like miniature cabbages, which are used as winter greens. After the sprouts are frosted, which makes them tender,

they are immersed in cold water for an hour, boiled in water for 20 minutes; when soft, drain them, put them in a stew-pan with cream or butter thickened with flour, seasoned with pepper and salt; stir them till hot, then serve them up with a little vinegar. They are used with every sort of meat by the richer classes, and stewed in rich gravies. To preserve their color, as with all kinds of cabbages, a lump of pearl-ash may be added. It requires similar culture to the brocoli.

A disease, common to the cabbage tribe, and called "clubb," arises from a worm in a hard case found at the root. The disease being indicated by the drooping of the leaves, the worm will be found to have eaten off the small fibres, if not the main root. It is more common in gardens and rich soil than in open and light sandy soils. It has been advised that young plants, before planting, be looked over, and the clubb brushed off, and that a little soot, mixed with lime, be sprinkled in the holes. Frequent turning of the soil is also useful.

The properties of the cabbage tribe are pungent and stimulating. They are nutritive, condimentary and antiscorbutic. Their pungency depends on an acrid volatile oil, composed of carbon, nitrogen, hydrogen, sulphur and oxygen. This oil becomes absorbed, and is found in the secretions. The nutritive properties arise from their mucilage, sugar and extractive matter.

The essential character of the brassica is—sepals 4, deciduous, cruciate; petals 4, alternate with sepals; stamens 6-2 short; stigmas 2; ovary superior; fruit a silique; seeds attached in one row. Herbaceous, annual, biennial and perennial; flowers yellow or white.

ACETARIOUS PLANTS.

This class comprises those plants which are eaten raw, blanched, or in their natural state. They are chiefly salad plants, seasoning herbs, &c. They are recommended for their coolness, pungency, and agreeable flavor. They contain little nourishment, but usually render the food with which they are eaten more grateful, and they are therefore the usual and valuable accompaniments of other dishes. They belong generally under the head and order of cruciferous plants. As most of the edible portions of these consist of the leaves and stalks, it may be remarked that the green matter giving color to the foliaceous parts is globular (called *clorophylle*), without alimentary properties and intermediate between fat and resin. It is little acted on by the stomach of man. It contributes, however, to the action of the bowels, and is thought, therefore, to disagree with dispeptic persons, by producing acidity and flatulency. Herbaceous vegetables, generally, are less suited for such persons than farinaceous plants.

Salad Plants and Pot-herbs.

The term salad is usually applied to two or more of any of the numerous salad plants, dressed with mustard, oil, vinegar, salt, pepper, or other substances, forming with them a consistence more stimulating and antiscorbutic, and calculated to correct any injurious effects likely to arise from the raw vegetable substances thus eaten. Most persons in health crave these salads, and they may thus enjoy them to great extent with impunity. The cucumber, though prepared in a similar manner, is a *fruit*, and does not, therefore, belong to the list of cruciferous plants. The radish and water-cress, and some other plants, may be eaten without this preparation. Some are spring, others summer, and others autumn and winter salads. Lettuce, endive and some others belong to the order Compositæ. The daisy, thistle, and leontodon are types of the sections of the order.

To forward salad herbs, the tomato, &c., in small quantities, a hotbed is made early in spring of heating substances, on which may be laid to the depth of 9 inches, leaf-mould, old tan, horse-stabling, or light compost. The seeds may be sown in boxes or flower-pots, and sunk in the bed to the top edge. Annual flowers may also be thus raised early. The pungency of some of these is owing to their volatile oil and sulphur, as with horse-radish.

CELERY, *apium graveolens*, C. 5. O. 2. sp. 1. Eh. B. 4 ft. This is a native of Europe. It is found in a wild state in ditches, marshes and on the sea-coast under the name of *smallage;* it is poisonous, with a very coarse unpleasant taste; but when cultivated, it loses these properties and becomes grateful and wholesome, especially by being kept from the light, so that its poisonous principle is not elaborated. But like all raw vegetable matter, it is inoxious only when completely boiled. The leaves abound with a cooling clear juice; but when the plant is old, the juice is milky and bitter. The leaf-stalks are eaten raw with oil, mustard, pepper, salt and vinegar, and also stewed and in soups; an agreeable conserve is made also of the blanched stalks. The roots of the *celeriac* (the turnip-rooted), are used for soups and salads. The seeds contain a fine aromatic scent and taste, and are used as a substitute, in soups.

Celery has come into general use within 30 or 40 years. The upright kinds are distinguished as the *red* and *white*, with solid or hollow stems. The red is most hardy and coarse; but is good for stews and soups. The unblanched leaves are eaten in soups by the Italians. There are various modes of cultivating it, the most common being to select a deep, rich, rather moist soil, or vegetable mould. The seed is sown in April, on a bed; and, in 8 or 10 weeks, transplant into nursery beds; and when 10 or 12 inches high, into manured

trenches, 18 inches wide, 6 inches deep, and 4 or 5 feet from each other; strip off the loose leaves, trim the roots, and water in the trenches. Earth them when dry, every 10 days, until covered 1 or 2 feet, to blanch; they may then be used in winter. Preserve the roots in winter in sand, and those in beds with litter upon side boards to form a shelter.

There are 3 or 4 varieties cultivated, the *white solid*, *rose-colored*, *Italian* and *celeriæ*, or *turnip-rooted*. Half an oz. of seed is sufficient for a bed 4½ by 10 feet; they are sowed and raked in from 20th of March to May, but the principal sowing is early in April. The plants are watered in dry weather and thinned when 2 or 3 inches high, then transplanted and watered and afterwards planted in trenches, as above. When dug, begin with a row and draw up entire. For seed, leave some good plants in spring, or set them out alone, 2 feet apart. The celariac are not put into trenches but are frequently watered when transplanted and occasionally hoed up. The roots are used in Sept. and Oct. They are excellent in soups, in slices, readily imparting their flavor. This is a common salad with the Germans, in which the roots are boiled tender and then eaten cold, with oil and vinegar; they are sometimes served up with rich sauces. The coat and fibres of the roots are cut away before boiling and then put in the cold water when first put on the fire.

The botanical species are A. *petroselium*, common parsley, (var. 1, *sativum*, common parsley; 2, *crispum* curled parsley, 3, *radice esculenta*, Hamburg parsley.) A. *graveolens*, smallage or wild celery, (var. 1, *dulce*, or common celery; 2, *rapaceum*, turnip-rooted celery. A. dulce; stem-leaves wedge-shaped; stem smooth, shining; radical-leaves pinnate, ternate; leaflets 3-cleft; umbels axillary; flowers small white.

SPINACH. *Spinacea oleracea*. C. 22. O. 5. Chenopodeæ. sp. 1. A. 1½ ft.—from *spina*, its seeds being prickly. This is a hardy annual, a native of Persia, and now much cultivated as a grateful and wholesome salad. Though not very nutritive, it is laxative and cooling, and is eaten when other vegetables are not allowed. The large succulent leaves are used as salads, but mostly boiled without water, except that upon them after rinsing. The flowering stems are hollow and branched, and the male flowers grow on different plants from those of the female, bearing the seed; the plant is therefore *diœcious*. 3 or 4 varieties are cultivated; one of the two most common has arrow-shaped and rough leaves, and those of the other are round and smooth. They are sown at different seasons; the latter grows faster, is larger and more succulent, and is sown in spring and summer; the first, for a winter supply, is sown in Aug. Frequent sowings are made from Feb. to Aug. *The prickly seeded*, sown in Sept., is best for winter or Spring, and the round seeded for summer. Another variety lately

from Flanders is said to be superior; and the New Zealand spinach differs from all.

Spinach makes a delicious dish, served up with gravy of roast meats, melted butter, &c. It is the only vegetable advantageously raised the last of the year. It should be picked clean and washed in 6 waters before cooking. It is then put in a sauce-pan, without water, salt sprinkled upon it and covered closely. When shrunk and the juice is evaporated, it is done. Then drain it well in a sieve and prepare it with gravy, butter and hard-boiled eggs; the leaves are also used in soups.

The seed is sown broad-cast, the plants thinned to 3 inches, and, as they increase, the distance is doubled. When left for seed a due proportion of male and female must be left. When the seed-capsules are set, the male plants are pulled. Spinach requires soil highly manured, an open situation and good weeding. If sown in drills, which is best, the drills are made 2 inches deep, a foot apart; the seed is scattered thinly and equally and the earth is matted down. The drills may be made between peas, beans, or cabbages. The plants are gathered when the leaves are 2 or 3 inches broad, either cut up or drawn. They are covered in winter. Sown broad-cast, 2 oz. answer for a bed 4½ by 30 feet; if in drills, 1 oz. suffices for the same space. French physicians consider this plant both physic and food; and hence call it the "broom of the stomach," sweeping and deterging every part of it without pain or interruption.

Wild Spinach. This plant grows wild on loamy soil, on waysides, among ruins, &c. The yellowish green flowers appear in June and July. It is perennial and is propagated by seeds, or offsets from the root. The leaves and stem, when young, are succulent; the latter is used like asparagus and the former as spinach.

New Zealand Spinach, (tetragonia expansa,) found growing wild there by Capt. Cook. It was recommended to the natives by the naturalists of the expedition and found excellent; and it is now naturalized in England. Wherever it has once grown, it springs up spontaneously. Its leaves are abundant and succulent in hot weather; it is milder and more rapid in growth than the common sort. It is an annual in northern climates. The stem has thick and strong branches; the leaves are green beneath and pale on the surface; heart-shaped, with apex pointed; and the whole plant is studded with aqueous tubercles. The leaves may be gathered in 6 weeks after sowing. It is found wild in many other places; leaves yellowish green, appearing in Aug. Leaves arrow-shaped, male flowers in long spikes, female in clusters on the stalks, at the joints.

PARSLEY, *Apium petroselinum.* C. 5. O. 2. Umbelliferæ. sp. 2-5 Fr. B. 3 ft.—named from its supposed medical qualities. It is a useful and pleasant vegetable growing wild in most climates. It has been

and now is used for dropsy in Holland. It is a garnish to meats, and *removes the taste and smell of onions.* It is a fine pot and seasoning herb, and gives an agreeable flavor to stews and soups. To preserve it for seasoning meats &c. it should be gathered dry, put into a tin roasting screen and placed by a large fire, where it becomes brittle; then rub it fine and put it up in glass bottles. Parsley is eaten greedily by sheep and cures them of the rot, and also some diseases of the horse; it also improves the flesh of sheep. Curled-leaf kind is the finest of several varieties. It is sown in March or April, and is 6 weeks in coming forth. With care, it may be kept green through the winter. It is said to be poisonous to fowls. *Celery* is a species of the same genus. For curing the liver-rot in sheep, it is sown among pasture grasses. The curled leaf and Hamburg, or large rooted parsley are principally cultivated for culinary uses in soups, &c.

The resemblance of cultivated parsley to "fools parsley," or lesser hemlock, has banished it from many gardens, as that is poisonous. The one can hardly be detected from the other. The leaves of the poisonous plant are darker green; and if bruised, emit an unpleasant odor, very different from that of parsley, and, when in flower, it has what is termed a *beard* hanging from every umbel. In the garden parsley there is but one leaflet at the umbel, and the hairs are very fine.

Parsley is raised from seed sown early in spring, commonly in single drills around the edges of beds. The leaves may be plucked in a few weeks, and a succession springs forth through the year, till May; when they run, bloom and seed in Aug. Horses and rabbits are very fond of it. It poisons birds and sometimes occasions epilepsy, or aggravates it in persons eating it, and it also inflames the eyes. The roots and seed are employed in medicine. The seeds are soaked 12 hours in water, mixed with sulphur, before sown, and should not be over a year old. The plants should be watered, and on gathering them, they are cut close and regular. The *Hamburg* parsley is sown in mould, well dug, in drills, 9 inches apart, or broad-cast and raked in; they are afterwards thinned to 9 inches. The Siberian, or single-leafed, may be sown early in fields with spring grain, or grass. It should be brought to the table with onions.

ENDIVE, or *Succory cichorum endivia*, C. 19. O. 1. Compositæ, sp. 5-7. A. 2 ft. A hardy plant from China, introduced and now naturalized here. It is cultivated as a winter and spring salad, and also for stews, &c. The French make great use of it raw, in salads, boiled, fried with meats, and as a pickle. It never disagrees with the stomach, but is cool and refreshing. It grows spontaneously in this country. The tops are profitable for cattle. In France the roots of C. intybud, dried and combined with coffee, give a more mellow and fragrant taste to it, greatly increasing its tonic and exhilarating quali-

ties. The roots are dried, roasted as coffee, ground and mixed in the proportion of 2 oz. to a pound of coffee. The wild succory contains a milky juice, used by physicians as a tonic and aperient. When blanched the bitterness is diminished. Chickory or similar plants constitute half the food of the Egyptians. Endive is probably derived from Arabia. The seeds are sown in drills in July, 6 inches apart and well weeded. The roots are taken up in winter, and packed in layers in a warm cellar, the crown of the roots being exposed, when in a few days they afford young leaves abundantly.

The varieties cultivated are the *green, curled-leaf, white* and *broad-leaf*. The 1st is best for main crops in autumn and winter; the 2d for spring, and the 3d is best for soups and stews. ½ an oz. of seed is required for a bed 4 feet by 10. May is a proper season for a small early crop, and June and July for a principal crop. Late supplies may be sown in August. The soil should be rich, mellow and exposed. The seed is thinly sown and raked in; and the plants, when 1 or 2 inches high, are thinned; when 5 or 6 inches high they are transplanted into prepared soil, and placed in shallow drills, 15 inches apart, with the plants 10 or 12 inches assunder. Water at planting, and if dry, once in 10 days afterwards; trim the ends of the leaves, and shorten the tap-roots. Plant some 1st of Sept., on a bank of light dry soil, a foot high, sloping south, to remain dry during winter. Some of the crop, with full leaves, may be tied up weekly, in dry weather, with strips in the middle to blanch. The *Batavian* variety is best for this. They blanch in 8 or 10 days; or 2 shingles may be set down, which, meeting at top, exclude the light, and thus blanch them. In winter they are covered with litter. Some strong old plants are raised in March for seed.

The root of chicory cut, dried, roasted and ground, is an article of commerce as a substitute for the adulteration of coffee; and this is adulterated with roasted peas, beans, grains, coffee-husks, &c.; it is preferred by some to coffee. The Venetian bole is used for coloring it. The fresh root is tonic, and in large doses, aperient. It has been used in the form of a decoction for chronic, visceral and cutaneous diseases, torpor of the liver, &c.

There are 5 species of *Chicorium*, viz. *Wild Endive* or *Succory, Common Endive, Prickley Endive*, &c.—C. Endivia—flower stalks axillary, in pairs, with single flower and the other 4-flowered; leaves oblong, somewhat toothed, alternate, runciate; flowers blue.

LETTUCE, *latuca* sativa, C. 19. O. 1., Compositæ, sp. 19-26. A. 3 ft.—from *lac*, on account of its milky juice, but corrupted by the English to *lettuce*. It is a native of most parts of the world, but the best was originally from Egypt, Aleppo and *Cos*, from which island the upright lettuce takes its name. It is cooling and soporific, and in this

respect is recommended in declining age, which is naturally wakeful. Pope has said

"If you wish to rest,
Lettuce and cowslip, wine *probatum est.*"

It is emolient and easy of digestion, but is not good for cold, weak, or melancholy temperaments, except medicinally. It is more wholesome in summer than winter. It allays thirst and the fumes of wine, and is altogether the best salad vegetable grown in open ground. There are 17 varieties cultivated, 6 of these are hardy kinds, suitable for our climate. There are 7 *cabbage* and 7 *Cos* lettuces; the latter are preferred for salads, but the other is best very young. An oz. of seed produces 400 plants. When getting too old, cut off the tops, and they soon spring up fresh and tender. For winter, they are sown in Sept. and covered in the cold months. Others are sown in March and April. When young, the cabbage-lettuce is best. Refuse leaves are good for swine, geese, ducks, &c. Indeed all lettuce should be eaten young, as it is said to be poisonous when in flower.

Whoever has command of lettuce, onions and cucumbers, it is said, may well dispense with most other acetarious plants. L. virosa, a poisonous plant, is thought to be the parent of our cultivated sorts, as our celery is naturally one of the strongest poisons. All the species have the qualities of opium, but these are most abundant in the wild plant. The juice is collected by incisions and by scraping off the thick juice, as with the opium of the poppy; it is little inferior to the opium of the East; it is called *lactucarium*, and may be given when opium is unadvisable. It is sown monthly throughout the year, and thinned and transplanted. Its succulency is also increased by watering. Blanching is promoted by tying up the leaves with strings when 2-3ds grown. Lime-water effectually destroys the snails and slugs. White and green *Cos* are best for the main crop in summer. *Brown Cos* is best for winter and in open ground; the *dwarf* of this is best. *Brown* and *white Silicea* are the best for stewing. *Imperial* and *cabbage* lettuces are among the best for summer salads, and continue longest in use. A bed of 4 by 30 feet, well supplies a family; or it may be sown among onions, carrots, &c. The soil is dug deep, the seed sown dry, covered lightly, patted down and raked over; the plants are thinned and put in drills 3 inches apart. Sowings are made every 3 weeks, and frequently watered when dry. For winter, it is sown in a warm sloping place 1st Sept., or in hot-beds or houses in Nov.

Lettuce opium of commerce is in hard brown masses, and is employed as an anodyne, antispasmodic and sedative. It is given to allay coughs, in phthisic and other pulmonary affections, to relieve nervous irritation and watchfulness, in febrile and nervous diseases, in which opium may not be used, and in spasms of the uterus. 3 or 4

grains are given; and 3 or 4 drachms have been used during the day. This may be collected by any one on cutting the plant, and many make a profitable business of it.—Leaves rounded; stem-leaves heart-shaped; flowers yellow, small—one species with crisped and another with 3-cleft leaves.

Strong-scented Lettuce (*letuca virosa*) is found about hedges, walls, and borders of fields; flowering in Aug. and Sept. It yields double as much opium as L. sativa, but is not so good.

MUSTARD, *Sinapsis*. C. 15. Cruciferæ. A. 4 ft. The seed was first obtained from Egypt. It is much cultivated here and in Europe, and the ground seeds are daily served on the table. An excellent sauce is made of this, eaten with fish or flesh, as it promotes an appetite, warms the stomach and helps digestion. It is also a wholesome condiment mixed with salads, in summer or winter. The seeds yield 35 pounds of mild and sweet oil to a 100 of the seed, on pressure. The white are used medicinally for asthma, rheumatism, palsy and for drafts in colds. A teaspoonful 2 or 3 times a day of dry white seed is good for disordered stomachs. A powdered infusion is used as an emetic, and in smaller quantities, as an aperient and diuretic. The seed in pickles give a fine flavor and render cucumbers more salutary. The leaves, when young, are valued as a salad herb, with cress, radishes, &c., or boiled with meats or greens. Two sorts are cultivated, the *white*, or S. *alba*, and the *black*, or S. *nigra*; the seeds of both afford the flowered mustard of the table, but chiefly the latter, which is the common kind, while the other is the best salad herb and is sown all times of the year. The seed must be esteemed abroad from the fact that, beside the vast quantity raised, England imports 17,517 bushels annually. The French use the must of sweet wine with the mustard for the table. All the species are hot and acrid, and they are often mixed. For the oil or flour, the seed is sown in rich soil the last of March, and kept free of weeds. Where once sown, it comes up spontaneously for many years. Half or a quarter of a wine-glassful of the seed, swallowed fasting, or early in the morning, is a powerful tonic and strengthener of the digestive organs.

For spring and summer, sow once in 10 or 12 days. In summer sow in shallow drills, in shady places from 3 to 6 inches apart, then cover half an inch. In Europe the white seed is ground for the flour, because milder. The black is larger, with darker leaves; it is grown in fields for the seed and for medicine. In moistening the seed flour for the table, milk is used, but it does not keep over two days. For the mill, sow moderately thick, broad-cast, or in drills, rake or harrow in thin, keep out the weeds and gather in August. It is often found wild among corn plants. It flowers in June and then produces round rough pods. It germinates quickly, like cress; and the seeds strown on a wet flannel or cork in water, quickly put forth tender leaves, and thus a salad is produced, at the fire-side, in a few days.

Physiological effects of mustard.—Mustard was employed medicinally by the ancients and is now an important article of the materia medica.

The black seed contains *myrosyne with potash, fixed oil, pearly fatty matter, gummy matter, sugar, coloring matter, free acid, a green matter, some salts,* &c. The seeds afford a peculiar acid and volatile oil, the latter being formed when water is added, as with some other fruits. The fixed oil forms 28 per cent of the seed; both are medicinally efficacious. Mustard, as one of the *volatile pungent stimuli*, is between horse-radish and pepper. Its acrid effects in topical applications depend on the volatile oil. Cataplasms cause, if long continued, vesication and, sometimes, ulcerations and gangrene. When swallowed, mustard causes the same effects on the stomach and bowels. In moderate quantities, it promotes appetite, assists the assimilation of substances difficult of digestion. In larger doses, it arouses the gastric susceptibility and becomes an emetic. Its general effects on the system are those of a stimulant; it quickens the pulse, promotes secretions, (particularly urinary,) and exhalations. It is recommended as a condiment to phlegmatic persons, and all with torpid digestive action; and generally with fatty or other food not easily digested. In malignant cholera, narcotic poisoning and some forms of paralysis, it is important as an emetic; also as a moderate stimulant in dispepsia, loss of appetite, &c. It is employed as a febrifuge in intermittents. Its common use, however, is as an application to the feet, or *rubifacient*. As an emetic, from a tea to a table spoonful is given in a tumblerful of water. In dropsy and some other diseases, *mustard whey* is a good form of administration. This is made by boiling half an oz. of bruised seed in a pint of milk and straining; given in small quantities twice a day. The poultice, or *cataplasma sinapsis* of physicians, is composed of mustard seed and linseed, with boiling vinegar, to form a proper consistence. This is rendered more stimulating by adding scrapings of horse-radish root. Crumbed bread is often substituted for linseed meal. Vinegar checks the formation of the acrid oil, so that a sinapsism without vinegar is as effectual in 6 minutes as one with it in 50. Water over 100° should not be used. In affections of the brain, as in the stupor delirium of low fevers and many other cases, it is valuable, applied to the feet; and also in pulmonary and cardiac diseases, it is equally effective applied to the chest. Its effects are quickened by the addition of the oil of turpentine. The operation should be watched that sloughing does not ensue. The effects and composition of white mustard are similar, but it is milder. The mustard flour of the shops is adulterated with wheaten flour, colored by tumeric and made hot by pod-pepper.

The manufacture of mustard is performed by crushing the seed between rollers and then pounding it in mortars. The mass is then

sifted, and a 2d sifting yields the pure flour. The *siftings* yield a fixed oil, by pressure, which is mixed with rape and other oils; the whole seed is never pressed. Mustard *cake* is used as manure, being too hot for cattle.

CRESS, *Lepidium sativum*. C. 15. O. 1. A. *common garden* cress, a species of the genus *Lepidium*, or pepper-wort. Its native place is unknown. There are 3 varieties cultivated, the *curled leaf*, *plain-leafed*, and *golden cress*. The first is used as a small salading herb, like mustard, and as a beautiful garnish. The 2d is the most common, because the seed of the first is not obtained genuine; it has the same flavor, but is not so handsome. The 3d resembles the 1st, but is more slender and dwarf. With mustard they form the principal ingredients in winter and spring salads, and with some all the year. It is grown as rapidly as possible, and cut when young and crisp. The seeds are sown as wanted for use; once in 8 or 10 days is not too often for delicate cress. Sowings are made in open ground, the 1st of April, in shallow drills 4 or 5 feet apart, or thickly broad-cast and earthed over slightly. The plants are occasionally watered. Late crops may be sown in hot-beds. Twice as much seed as that of mustard is required, though not sown so frequently; an oz. for a bed of 4 feet square is requisite. The *curled* and *broad-leafed* are most cultivated here. The soil should be mellow. For seed, sow in spring, or leave some rows of old crop.

WATER-CRESS, Nasturtium officinale, C. 15. Cruciferæ, sp. 10-24. P. 1 ft. It has warm cordial qualities, which have been thought to infuse life into dull and stupid persons, and to brighten the understanding. An ancient proverb says, "eat cress and learn more wit." It has been so named from its acrimony, signifying a convulsed nose. It is notorious for its antiscorbutic properties, and may be eaten at all times of the year. Cresses are much esteemed in the London market, and are in very considerable use here as a salad-pot-herb. They grow in rivulets and springs here and throughout Europe. As a salad herb the young leaves are very popular, being supposed to purify the blood. The creeping water-parsnip, which is pernicious, is often gathered, through ignorance, instead of this purifying plant. They are grown on running streams with sandy or chalky bottoms, or fresh pools. By throwing the seeds upon them they soon propagate abundantly. Garden cress, or pepper-grass, may be raised 4 or 5 times a month.

In Germany great pains are taken to propagate this plant, and artificial water beds are formed, called *cress plantations*, and the water let on or drawn off as required. Near Paris, also, it is cultivated with care near wells, and water is poured upon it daily. In England it is grown in beds near small streams, and sunk a foot under water. A stream of water through an inch pipe will irrigate 1-8th of an

acre. The land being sloping, a current is produced, and cresses are produced in all winter months, if not allowed to flower. The ground is laid dry 2 or 3 times a year, and weeds, &c. removed. But living streams are best.

WINTER CRESS, or Early Hedge, *Barbaræa vulgaris*, C. 15. sp. 4-6. D. P. 1 ft. A species of mustard growing early in spring. It is a native of this country and of Europe. It is of a hot and biting nature, and the young leaves are a principal ingredient in salads most of the year. The *Normandy cress* is found to be less acrid, more pleasant, and is now coming into general use. It is sown in light soil in September, and as a breakfast herb in winter it is very fine and wholesome.

WATER LILY, *Nymphæa*, C. 13. O. 1. sp. 10-20. A. P. A beautiful genus of aquatic plants upon our lakes and slow waters, affording a tuberous root as large as an egg, which is eaten cooked in various ways. The seeds are also used in some parts to make a kind of bread, and they were thus used by the ancients. The *sweet scented* and *small sweet* are peculiar to this country.

INDIAN CRESS, *Tropæolum majus*, or Nasturtium indicus, C. 8. O. 1. sp. 5-13. A. 1-6 ft. This is an ornamental annual and a valuable culinary plant. It is a native of Peru, and was brought from thence in 1580. The flowers and the young leaves have a warm pleasant taste, and are much used for salads. The young seeds pickled in salt and vinegar are used as a substitute for capers, and by some preferred. It is a good antiscorbutic, and the young leaves and flowers are used for weakness or pain in the stomach, arising from cold and flatulency; they also form a brilliant garnish. 2 varieties are cultivated here. In the evening the flowers emit, at certain intervals, sparks like those from an electric machine, which was first observed by the daughter of Linnæas.

The genus to which this belongs is before spoken of under the head of *Nasturtian*. Common Cress is a species of *Pepperwort*. *Spanish Cress* is of the same genus.

FENNEL, *anethum fæniculum*. C. 5. O. 2. sp. 4. Dh. P. 6 ft. A plant growing wild here and a native of the S. of Europe. The stalks and the leaves when boiled are used in fish sauces and also with pickled fish and pork, and raw as salads. The whole plant is good in broths and soups and the stalks are blanched for winter salads. The juice is said to clear film from the eyes, taken when the stalk is nearly grown. A distilled water from the seeds is used medicinally; they are an excellent stomachic and carminative. In all its uses the plant is good for the stomach. It is easily cultivated. The seeds are imported from France, and are used in making gin. Fennel is a species of dill. It is 5 or 6 feet high and the leaves are divided into fine long segments of a bright green. Its flowers are yellow and appear in July and Aug. It has a strong disagreeable odor. In France and Spain it is much used put up with olives and pickled pork.

This, like many other garden herbs we have noticed, may be commended by saying, with Pliny, that a good house-wife may go into her herb-garden, instead of a spice shop for her seasoning, and thus save the health of her family by saving the contents of her purse. Fennel requires little culture; for where a plant is once established, it will continue to grow for many years. The seeds are sown early in spring, broadcast or in shallow drills, 6 or 8 inches apart, and when a few inches high the plants are thinned out or transplanted. When wanted early the roots may be slipped off and planted a foot apart, when they will soon produce a supply of leaves. They may be cut down in summer to produce young leaves below and to keep the plant from spreading if desired.

The sweet fennel (dulce) or *Finochino.* The sweetness of this variety lies chiefly in the seed which is used medicinally. The stalks are the edible part. In cooking it should be half an hour in water, then parboiled and drained and then cooked in a stew pan in rich gravy till tender. The stalk is earthed up to blanch the leaves, which is done in 10 or 12 days. By successive sowings and cutting down, a supply is had from June to Dec.

The properties of the seed of the sweet fennel depend on aromatic oil. De Candolle regards the sweet fennel as a distinct species, and others as a variety. It differs from F. *vulgare*, before described, in many particulars, and affords the sweet fennel seeds used in medicine. The 2 kinds known in trade, are the *short* and *long*. The latter being most esteemed. The plant is an aromatic stimulant, like dill and anise. It is given in the flatulent cholic of children and as a carminative with griping medicines. *The oil* is obtained by bruising seed and distilling it with water. 19 cwt. of seed produce 78 lbs. of oil. Dose from 2 to 20 drops. This is more agreeable in odor and taste than that of the wild fennel. *Fennel water* by decoction is commonly used as a carminative to relieve the flatulent cholic of infants and otherwise as above.

CORN SALAD, *Fetticus*, or *lamb's lettuce.* C. 3. O. 1. sp. 15. A. *veleriana olitoria.* This is a species of *valerian*—from *powerful*, a native of this country and Europe, and a plant of mild agreeable taste and flavor and found wild in corn-fields; hence its name. It is cultivated as a winter and spring salad and called *lamb's lettuce* or *fetticus.* It is dressed like spinach. A recent and improved variety has lately been introduced. The seed is sown as soon as ripe in Aug., otherwise it remains a long time in the earth. A warm spot is selected and the seed is sown broad-cast in a bed or in drills 6 inches apart. When well up the plants are thinned to 3 or 4 inches and the leaves are picked when wanted.—Flowers triandrous, blueish white; leaves linnear, obtuse; stem 2-forked. V. dentata is the tooth-seeded corn salad.

BURNET, *Poterium sanguisorba.* C. 21. O. 7. sp. 6-7 Eh. P. 2 ft. A hardy perennial plant, growing wild, but now much cultivated for the use of the leaves in culinary purposes, especially as salads and in soups. They have a warm pleasant taste. The French use them much for soups. They continue green through the winter, in the absence of other salads. A drink was made of the plant which was considered useful in many complaints; it is also used in cooling drinks. This species is sowed with clover. The leaves when bruised, smell like cucumbers and taste something like the parings. All the species are easily cultivated. It is found a foot high on dry soils. Its flowers appear in greenish heads in July. A few seeds are sown annually in the spring in drills, then transplanted into rows 6 inches apart.

CORCHORUS. C. 13. O. 1. Tiliaceæ. sp. 7–25. 1-3 ft. The name of a culinary plant and supposed to be the same as that known as C. olitorius. This is extensively sown about Allepo as a pot-herb, and eaten with meats; in France it is called *maue-de juif.*

SALSAFIE, *Tragopogon porifolius.* Dh. B. 4 ft. This plant belongs to the genus *goat's beard.* It is a hardy plant resembling the parsnip, growing in meadows with purple flowers. It is wholesome and nutritious, has a sweetish and delicate flavor and forms a variety of excellent side dishes during the winter. The root, when dressed with cream, is delicious. Scrape them lightly, lay them in water, for an hour, boil till quite tender, take out and drain. Make a thick batter of eggs and flour, dip in the roots and fry with a small piece of butter till brown. In the spring it may be dressed like asparagus. It is sometimes called the *vegetable oyster* from a similarity of taste. The root is long, white, tapering and fleshy. It grows wild in the S. of Europe. It is propagated by seed sown on light, rich soil, in April, in shallow drills a foot apart; and the plants are thinned, hoed, and when taken up in Nov. are laid in sand for winter use. As with all such vegetables, if the winter be mild and the roots take a 2d growth, they must be taken out and relaid. The flowers are of a dull purple color, closing at mid day. It should be found in every garden; its value has not been appreciated here.

COMMON NETTLE, C. 21. O. 4. *Uritica.* sp. 32–69. A 1–3 ft. A plant common in this country on waste land and pastures. The tops and leaves are eaten when tender and boiled, as greens, which, when mixed with other food for poultry, is said to promote their laying eggs. A rennet is also made by the liquor of boiled nettles and salt, in the proportion of three pints of the former to a quart of the latter; a table spoonful of it will coagulate a bowl of milk. The fibrous stalks, dressed like flax, or hemp, may be made into canvass or paper. The boiled roots give a yellow color to woolen, linen or cotton. The *stings* of nettles are curious. They are slender and hollow, with a minute hole at the bottom and a bag at the base. The pressure, when

entering the skin, forces up from the bag into the wound a corrosive liquor which excites inflammation and a blister. They have been used to restore sensation in paralytic limbs; also in syrup as a styptic medicine, in jaundice, scurvy, gout, &c. The flowers and seeds have also been used efficaciously as a substitute for Peruvian bark in agues. A leaf put on the tongue and pressed against the roof of the mouth is said to stop bleeding at the nose. The leaves are the food of the caterpillars of 3 of the most beautiful butterflies. The juice of the nettle, or that of the dock is a remedy for the sting. 4 species are generally known. The race of nettles is much more difficult to destroy than to raise. Attention has lately been called to the Canadian thistle to prevent its growth by penal enactment, it being one of the greatest pests of the farmer; but, cannot cordage or paper be formed of it to advantage?

SOW THISTLE, *Souchus*, C. 19. O. 1. Compositæ. sp. 25–40. Dh. ft. 1½–6—from hollow or soft, in allusion to the softness of its stems. It has similar properties with the dandelion and succory. It is a favorite food with sheep and rabbits. The young leaves are boiled and eaten as greens; and the smooth variety, boiled like spinach, is superior to most others.

S. floridanus, of Florida, is used for the bite of the rattlesnake in the same way as Prenanthus serpentaria. It is called in the country *gall of the earth*. It is a native of the U. S. 5 sp. N. A.

SORREL, *Rumex acetosa*, sp. 17-79. P. ½ ft. This is found growing wild in this country and Europe in grassy pastures. It is used as a pot-herb, as a *green sauce* for roast meat, veal and pork, and as a substitute for apple-sauce in winter. It is, like spinach, put into a saucepan without water, except that on the leaves when washed, boiled slowly, then beat up with a piece of butter, eggs and cream, and stewed like spinach. The leaves are boiled, and the milk of the rein deer added to the water by the Laplanders. The Irish eat them with milk and fish. There are 2 or 3 varieties, but the French is the best for culinary purposes, it having larger leaves than the common. The use of sorrel as food and medicine was well known to the ancients. A decoction is cooling, diuretic, grateful to the stomach, allays heat in fevers, quenches thirst, and is an excellent antiscorbutic. A good drink for spring and in inflammatory and febrile fevers, is made with a handful of sorrel boiled in a pint of whey. No remedy, indeed, is better for the scurvy, if eaten green, or the juice is drunk. The *wood-sorrel* is best for these purposes. Soups and sauces in France are mostly made with sorrel. It is a species of the *Dock*. 2 or 3 varieties are cultivated. The seeds are sown in a bed or border early in spring, raked in, and the plants trimmed and transplanted in rows. They are supplied well with water, and the leaves are cut last of summer; they continue for many years. The parted roots, planted out, are best.

This genus is allied to Rhubarb. The *Alpine Dock* is superior in its medical powers.

R. acetosa—diœcious, male and female flowers on seperate plants; leaves oblong, arrow-shaped; flowers reddish, clustered.

OXALIS, *plumieri*, Wood Sorrel, C. 10. O. 4. Oxalideæ. sp. 72-15. A. 1-2 ft. A species of the sorrel brought from Lima in 1832, where its leaves are much used in salads, and medicinally for cooling and purifying the blood. The root, which is bulbous, is now highly extolled, being more agreeable than the potato, the taste of which it resembles. (See under head of *tuberous roots.*) In cooking, the tubers are boiled 10 or 15 minutes, the water is drained off, and they stand in the sauce-pan a time to dry. The *oxalis* is of a peculiar shape and color, and is believed to be very nutritious. Extensive orders are now given for it to plant. It should be speedily introduced. It may be cultivated like the potato. Its stalks are good, when green, for cattle, and it is believed to possess many medicinal qualities. All of the varieties are without leaves half the year. Some species only have fleshy roots. The little bulbs are often very numerous. Some have fusiform roots, and all are very anomalous and singular. All, too, are more or less acrid, and some produce seeds, by which they are propagated, or by offsets. They are grown in light sandy soil. The O. acetosella is used as a salad plant, its acid resembling that of the lemon or tartar, and an infusion of the leaves is antiscorbutic, refringerant, and diuretic, as is the plant in milk. This is given in ardent fevers, as it allays inordinate heat and thirst. The expressed juice affords an acid salt, used for removing moulds and ink stains, under the name of *oil of lemons;* but it is seldom genuine. The stained part is dipped in water and the salt sprinkled on, then rubbed on a heated plate, and washed in warm water. 20 pounds of fresh leaves yield 6 pounds of juice, and 2 ounces of salt, on evaporation and cooling. *Wood Sorrel* is indigenous to this country, and abounds in woody places and borders.

LOVAGE, *ligusticam*, livisticum, C. 5. O. 2. Umbelliferæ, sp. 10-20. Dh. P. ft. 1-6. This is sometimes used as a pot-herb or salad ingredient, and is considered a corrective and purgative. An infusion of the leaves and roots, containing a fetid gum, used as a purgative to calves. The seeds are used by distillers for preparing a liquor called *lovage*. There are 7 species of lovage and 13 in the genus.—Leaves repeatedly compound; stem 5 ft. high; flowers small, yellowish, in June. Italy.

ANGELICA, *archangelica*, C. 5. O. 2. Umbellatæ, sp. 6. B.—from *angelic*, the roots and leaves being supposed to have extraordinary virtues. A native of the N. of Europe and of this country; it is propagated by seeds sown in August on moist soil, and transplanted when 6 inches high. The stalks were eaten as celery; but stalks and

leaves are now mostly used as a sweet meat candied by confectioners. In Lapland it is used for coughs and colds. The roots are aromatic and fragrant. It is occasionally found a native of cold and moist places. It was called "the Holy Ghost," by the superstitious, formerly, and it was supposed to drive away pestilence.

The dried roots of the shops are imported from Hamburg in casks. 386 cwt. were imported into England in 1839. The root has a cylindrical form, 6 or 8 inches long, of a brown color. When cut it exhibits a liquid of a strong but sweetish odor. The seeds have the same, though less strong taste and odor. The composition of the root is *volatile oil*, *acrid resin*, *bitter extractive* (31), gum, with common salt (31), water (17), albumen, &c. The roots and seeds are pungent, stimulants and mild tonics. They are now much used in preparing gin and bitters by rectifiers.

STONE CROP, *sedum*, C. 10. O. 5. Semperviveæ, sp. 41-60. Eh. P. ft. 1. These plants grow on the bare rock. They are low succulent plants, and some are pretty or curious. 2 or 3 species are called by the French, *orpine*. Some have the properties of the house leek, and others are pickled, like samphire. The juice applied to the skin blisters it; taken inwardly, it vomits; and applied externally to gangrenes, it promotes suppuration. They are eaten mixed with salads in Holland. They are very decorative plants. 16 species are common.

MYRRH, *myrrhis*, C. 5. O. 2. Umbelliferæ, sp. 1-2. Fr. P. ft. ½. A plant long cultivated. The young leaves have been used in salads, and the roots were boiled, or eaten cold or in tarts, in a variety of sauces, or candied. The seeds are used in soups, and also in polishing and perfuming furniture and floors. The medicinal and fragrant gum of this name we speak of under medicinal plants.

GOOSE-FOOT, *Chenapodium*, C. 5. O. 2. Chenopodeæ, sp. 34-72. A. ft. 1-3. Leaves similar to the webbed feet of a water fowl, and covered with powdery granules. The whole genus consist of succulent herbs. C. bonus is cultivated as a perennial spinach, and its leaves are applied to wounds, and for cleansing old ulcers. C. album is the most common, and is boiled and eaten as greens, but for this purpose C. maritium is the best of all the species; and where it abounds it is burned with *salsofu kali* and other marine plants, to produce soda.

TETRAGONIA, C. 12. O. 2-5. Ficoideæ, sp. 10-16. ft. 1-6. The species of this genus are succulent trailing plants, but all are believed to be fit to be used as a spinach. As a summer spinach, T. expansa is now thought as valuable as O. vache. The New Zealand spinach, if well watered, grows freely, with very succulent leaves, in the hottest weather. It will doubtless come into general cultivation. It is sown the last of March. It grows in pots; the plants are set out in May, 3 feet apart, in rich soil; and in 5 or 6 weeks the leaves are fit for gathering.

TARRAGON, or Dragon's-wort, is a perennial plant of a hot or biting character, a native of Siberia, brought to England in 1548. It is frequently used in salads, especially by the French, to correct the coldnsss of other herbs; and the leaves and young tops are used as ingredients in pickles. They are eaten with beef-steaks, served up with horse-radish; and an agreeable sauce for fish is made by their infusion in vinegar. They have a fragrant smell and aromatic taste, and are much used in soups. But one variety is cultivated for these purposes. It is propagated by parting the roots in April and planting them in a light rich soil; it is also increased by slips or cuttings in June and July. When well rooted, they are planted in a dry sheltered spot, 6 inches apart. They are forced in boxes in a hot-bed, like mint.

SYLYBUM, C. 19. O. 1. Compositæ, sp. 2-5. Dh. ft. 4. A plant formerly much cultivated, and the young leaves used in spring as a salad, or boiled as greens. The young stalks, peeled and soaked in water, are said to be excellent. In the spring of the 2d year the root is prepared like salsafie or skirret, and the receptacle of the flower is pulpy and eats like that of the artichoke. In some places the whole plant is used as fodder for cattle.

ROCK or SEA SAMPHIRE, Crithmum maritimum, C. 5. O. 2. D. P. 1 ft. An umbelliferous plant growing abundantly on the sea-coast of England, and on cliffs in the South of Europe. The flowers, pickled in vinegar, are used on the table, and as salads and pot-herbs in some places. A more common kind, growing in salt marshes, is also much used; but is inferior, and without the fine aromatic flavor of the *marsh samphire* (*Salicornia*), of class Monandria. Hazardous pains were formerly taken by those who collected this plant in England from the precipitous sides of high cliffs, being suspended in the air by ropes, as Shakspeare says, "Half way down;—dreadful trade!"—Leaves thrice ternate, leaflets lanceolate, stems a foot high; flowers greenish white.

PICRIDIUM, C. 19. O. 1. Compositæ, sp. 3. A. ft. 1½. Cultivated as a spring salad; and, if cut before being too old, is an excellent vegetable, with a pleasant flavor, and devoid of the bitterness of endive, and of the insipidity of young lettuce.

WATER-LEAF, C. 5. O. 1. Borragineæ, sp. 3-6. Dh. P. ft. ½., or, as better known here, *shawanese salad*, it grows in marshes in this country. There are 2 species, both humble plants. H. Virginicum is the species used as a salad.

ALISANDERS, *Smyrnium*, C. 5. O. 2. Umbelliferæ, sp. 6-7. Dh. P. ft. 1-3. A genus of plants smelling like myrrh. Some of the species are cultivated like asparagus and salad plants. They resemble celery, and are cultivated in a similar manner.

ASPARAGINOUS PLANTS.

These comprehend those with pulpy stems, buds and bottoms of compound flowers; and, unlike brassica, salads, &c., they are subjected to culinary preparation before being eaten. All young shoots were formerly as asparaginous plants. From their nature and growth, their cultivation is somewhat more expensive than most others used as succulent food.

ASPARAGUS, *officinalis*. C. 6. O. 1. Asphodeleæ. sp. 2-32. Dh. P. 4 ft. A well known edible plant in this country and Europe. It grows wild in many places, but in this state it is only a few inches high and a 4th of an inch thick; whereas in its cultivated state it is 4 or 5 feet high. No vegetable has undergone greater improvement by cultivation. It is one of the oldest as well as choicest luxuries of the garden and of the season. It has a perennial root and an annual stem and is brought forward in hot beds or houses; it is in season in May and June. It is raised from seeds; the plants remaining in the ground 3 years before being cut, after which they afford a regular supply. The head, if cut transversely, displays a beautiful example of vegetable anatomy. The shoots are exogenous, growing from the surface like the palms, unlike common trees which grow from the centre. The head of the young plant is edible only so far as the part extends which is to flower and produce leaves. Thus the part eaten contains the rudiments of hundreds of branches and thousands of leaves. It is thought to promote appetite but it is not very nourishing being chiefly a luxury. It is esteemed a diuretic; it gives a peculiar odor to the urine; and sedentary operatives and others resort to it when troubled with symptoms of gravel. Its peculiar qualities are due to a principle called *asparamide*, formerly called *asparagin*, which it contains.

The young shoots are boiled 20 minutes, and when soft, are served up with toast and melted butter. When well seasoned, they likewise make excellent soups. The markets of our chief cities are well furnished with this vegetable in its season. A person near London has under constant cultivation 80 acres of asparagus. There are 3 or 4 varieties, all very similar. It is a native of cold climates, being indigenous in Russia and there eaten as grass by cattle. It is found wild on the seashore, but it was cultivated and eaten by the Greeks and Romans, who were so skilful in its cultivation that 3 shoots weighed a pound.

A sandy loam, deeply trenched and manured is prepared for it. The seeds should be fully ripe and from the strongest and most compact shoots. For a bed 4 by 6 feet a quart of seed is required; and for a bed 4 by 30 a pint is sown. It is transplanted a year old, in 4

rows 9 inches distant, when 160 plants are required for the latter bed. The seeds are sown as early as the spring permits, or 3 weeks before frost sets in, in autumn—press the earth well down when frosts begin. Cover the ground with litter a foot deep, with poles on it; and when removed in spring, the plants will soon be up. Alleys should be left between the beds which may be 2 feet deep; and trenched to that depth, with manure in the bottom. When transplanted, do it immediately after taking the roots up. When not to be transplanted, sow 2 or 3 seeds in places designed for 1 stalk, cover an inch deep and thin, when up, to right distance.

Shoots of 3 years old, some say, are better for planting than those of one. In March and April the beds are forked and dressed, and weeds kept out, with occasional waterings, till 3d or 4th year. Let the crop for 2d and part of 3d year run to stalks. Onions or lettuce are often sown on the ground, the 2 first years. The beds are loosened every spring with a fork, avoiding wounding the roots, and raking the soil again before the tops shoot. The tops are cleared off when the frost has touched them, and a coat of manure strewed over the bed. The sprouts grow large and tender in shaded ground, but are not so early.

The shoots of the 2d year may be cut off till middle of June, but afterwards should run to seed. Gather the tops in regular order and in the proper season; when they are 3, 4 or 5 inches up, cut them below the ground, slanting an inch. Leave 2 or more shoots to each stool if you cut later than the 20th June, to draw nourishment to it.

After 10 or 12 years, asparagus declines; plant other beds, therefore, a year or two beforehand, allowing 3 or 4 years for production. Select the finest and earliest heads for seed, in the spring, tie them to a stake during summer, wash out the seeds in autumn, when quite ripe, or keep them in the berry, in a dry place till sown, if for domestic use.

An old shaker gardner says, make the bed as soon as the frost is out of the ground, work this to the depth of the spade blade, mix it well with rotted horse manure, sow in rows cross-ways of the bed, 20 inches apart, one inch deep, and rake in lengthwise of the bed. When the cutting season is over, hoe lightly and even over the surface. Every other year spread on an inch of yard manure before hoeing.

Cut the dry tops close early in spring, spread and burn them evenly on the ground, hoe and rake the beds over. Thus large successive crops have been cut for 25 years. A pickle of salt and water applied to the beds in spring is said to be highly serviceable, or a bushel of salt to a bed of 50 feet by 6. When forced, obtain three year old plants (none others are fit) from hot-beds of stable litter, or recent manure, tanner's bark, leaves of trees, grass, or herbage, all mixed and laid—set the plants at two inches. The *red* and green top are the varieties cultivated; the first is larger, fuller and closer, but is not

of so good a flavor as the second; it may be grown, however, in sea sand, manured with sea weed; and this has suggested the idea of cultivating it on the barren sea coast.

ARTICHOKE, *Cynara Scolymus*, C. 19. O. 1. Compositæ, sp. 7-10. Dh. & P. 4 ft. A native of Africa and the S. of Europe. It has been much improved by cultivation in northern climates, and is now a highly esteemed esculent plant. It is naturally a maritime plant, like the Sea-Kale, though it thrives best on soil having decayed vegetable matter. Burnt sea-weed must be good for the soil. The parts of one variety eaten are the receptacle of the flower; and the *chokes* are the unopened florets, separated by bristles, which are removed, but which, if swallowed, occasion a sensation of choking; and hence the name. The heads, before the flowers are open, are boiled in salted water till soft; the scales are then plucked off, and the bottoms dipped in melted butter, well seasoned, and the fleshy substance is sucked off. It is eaten raw as a salad with salt and pepper; but stewed, boiled, and in milk, it is a standing dish at French breakfasts; or made into ragouts, pies, &c. For winter use the parts are dried in the sun and put up in paper.

There are 3 varieties cultivated, the *conical*, *oval* and *globe*; the first 2 being the best. The first is of dark purplish tint, with the scales much turned in at the top. This is preferred for the main crop. The scales or edible part, possess most flavor, and are thicker in the *conical*; but more tender than the *oval* or French, and should be cultivated on this account. Both produce the heads from July to November. They are propagated by rooted suckers from the old plants 1st of April, or by seeds; and they continue productive for 6 or 7 years. The flowers are often used to coagulate milk for cheese. The juice of the stem and leaves, mixed equally with white wine, is used for dropsy, when other remedies fail. With bismuth, it gives a golden color to wool.

The plant requires a light rich soil, rather moist, well dug and manured; the sets are planted with a dibble, 4 feet between the rows, and 2 in the row, giving them water occasionally, if dry, and keeping them free from weeds. In autumn the large decayed leaves are removed, and the rows manured, and in cold weather they are protected by earth. In spring, a few are left for shoots. Sea-weed is a good manure for this plant. It is cultivated in England in gardens, chiefly of the higher classes, by whom it is considered a luxury. It is still more cultivated on the continent. The florets are bent down for seed, to prevent rotting.

The Cardoon, the name of which has been applied to the Jerusalem artichoke, is considered as belonging to asparaginous plants. The stems and young leaves are blanched and rendered crisp and mild; and they are also used in soups and salads in the S. of Europe.—Leaves

pinnate and divided; calyx undivided; flowers blue or purple; root-leaves 2 or 3 feet long.

SEA-KALE, or Colewort, *Crambe maritima*, C. 15. sp. 10-15. 1½ ft. This plant grows wild in Egypt, and spontaneously on the coast of England. It is not much cultivated in this country, though its merits commend it to general attention. It has been described as combining all the good qualities of the cabbage; and, as Dr. Curtiss says, "a sweetner of the blood in the spring," &c. It thrives well on sandy loam when transplanted. It should be eaten when tender; and it is boiled like cabbage. It is propagated by seed, but it may be raised by slips or pieces of the roots. The people of the coast watch its first appearance, and cut it off underground, like asparagus, and boil the herbage as greens. It is forced by taking up the roots and planting them in hot-beds, and covering, as with others of the brassica, in the winter.

The ancient plant, *Crambe*, was probably derived from this plant. The people of Ireland long used the wild plant before it was cultivated in England, and it has therefore been but recently introduced as a cultivated esculent. With Rhubarb, says Dr. Curtiss, "it may save many pounds for medical attendance, and people may soon say, 'I grow my own medicine.'" It has been further said by others, "it is one of the most valuable acquisitions made to culinary vegetables within the last 50 years; none affording a more salutary esculent for 4 or 5 months of the year." The cultivated kale is soaked in water half an hour, well boiled in salted water, drained, laid before the fire a few minutes, and dressed with melted butter, capsicum or tomato, vinegar; or, use veal gravy, cream or milk, thickened with flour and butter. No plant requires less culture; the processes being similar to those practiced with other varieties of the brassica.

SPICES.

BLACK PEPPER, *pipper-nigrum*, C. 2, O. 3, sp. 44-250, E. 6 ft., the dried berry of a climbing plant growing in the E. Indies. The pepper grounds are laid out into squares of six feet for each plant, by the side of a shrub upon which it creeps and bears in bunches from 20 to 50 grains, like currants. When these begin to redden, they are gathered, spread on mats in the sun, when they dry black, and are packed for exportation. *White pepper* is the best of these berries, gathered when ripe and stripped of their skin, being steeped in salt water a week for this purpose; they are then dried, rubbed between the hands and winnowed. As the acridity is in the skin, principally, these are less pungent than the black. Pepper is an article of much commerce; that from Malabar is best. The sales of the E. India Co. have been six million pounds annually, 800,000 lbs. being retained for

home consumption. Ground pepper is much used for culinary purposes, and often as a stimulating medicine. No less than 3,682,342 lbs. were imported into G. Britain in 1840.

The productions of pepper are Sumatra (west coast) 20 million lbs.; do. (east coast) 8 millions; Straits of Malacca 3,600,000; Malay peninsula 3,733,333; Borneo 2,666,667; Siam 8 millions; Malabar 4 million lbs. There are annually imported into the U. States about two and a half million lbs., though much of this is exported. The value imported in 1840 was $189,928.

Botanists reckon about 60 species of pepper, some of which are found in every quarter of the earth, except Europe. The black is a perennial found on the sides of mountains. It was at one time the principal export from Java. The plant has been introduced into Cayenne; and one plantation contains more than 30,000 plants. Malabar is the chief pepper country of India. The plant is propagated by shoots, which bear the 4th year, decline after the 8th, and cease to bear after the 10th or 12th. Each bunch contains 20 or 30 berries, and 6 or 7 lbs. are afforded by a tree. The harvest in Sumatra is in Sept. and Oct., and a smaller crop is often gathered in March. The plants are constantly watered and kept perfectly free from weeds. The white pepper is from the same tree and the best is thought superior to the black. The 3 sorts are, 1st, *Molucca*, 2d, *Catongee*, and 3d, *Negaree*, which is the lightest and worst; the berries should therefore always be weighed.

The Greeks derived their knowledge of it from the Hindoos, and their physicians used it in several diseases. The finest kind is called *shot pepper*, from its hardness. It is sometimes deprived of its husks by trituration, or is bleached by chlorine. White pepper (*piper album*) is the fruit of the external fleshy part, and is larger, less acrid and pungent than the black.

The Long pepper is found wild in India among bushes on water courses, and is cultivated in Bengal. The roots, cut and dried, are an article of commerce all over India. It (piper longum) is an inch in length, with a mild aromatic odor and violent, pungent taste. It is more acrid than the black, and its composition, uses, and medicinal effects are similar. It is much used for culinary purposes and in many pharmacopœial preparations.

Cubeb pepper resembles the black, but is lighter and the plant is different. Its analysis also exhibits some different principles, which distinguish it. It is much used in medicine, chiefly for the same purposes as the black, but especially for gonorrhœa. Several medicinal preparations are also made of it. The Indians macerate the berries in wine and drink it to excite their passions. In affections of the bladder and prostrate glands they are given in powder, from 10 to 30 grains. The volatile oil is obtained by distillation. This and other preparations of Cubebs are used medicinally.

There are numerous other species of the piperacea, but these are the chief of those much used.

The composition of black pepper is *resin, volatile oil, peperine, extractive, gum, bassorin, starch, malic and tartaric acids, woody fibre and salts.* White pepper is similar, with water, &c. *Peperine* is employed in medicine as a febrifuge in fevers, and is thought to be as speedy and certain as sulphate of quinia. Doses, 6 or 8 grains in powder, or pills.

Its ordinary effects are well known; inflammatory symptoms succeed its use in quantities; it acts as a stimulant, accelerates the pulse and excites the mucous surface. It has a well-known influence over the morbid condition of the urino-genital organs. It is chiefly employed as a condiment, for its flavor and stimulant effects on the stomach, by which digestion is assisted, and for a torpid state of the digestive powers. Infused in spirits, it is a popular remedy in intermittent fevers, taken just before the attack. Warm water, with pepper, has long been taken for cold fits. It is employed in paralysis of the tongue, &c. as a masticory. It is also used as an ointment, and mixed with mustard in poultices, &c. A dose of black pepper in corns or powder is 5 to 15 grains; the powder is given in the form of pills. The *Pepper confection* of physicians, for piles, &c. is composed of black pepper, Elecampane root, or liquorice root, of each equal parts, in powder, Fennel seeds, honey, and white sugar, of equal parts, rubbed to a powder—dose, 1 to 3 drachms twice or thrice a day, introduced into the rectum in a solution, and persevered in, if necessary. Gently opening medicines are given occasionally, in the mean time.

CAPSICUM. Solaneæ, sp. 18-24. A. 1 ft. Species of plants of great value as a spice in this country, E. and W. Indies and S. America. They bear pods of various colors and size, with small flat seeds. The principal of these are the *Bell Pepper*, *Guinea* and *Bird Pepper* (C. lattatum), all possessing the same general qualities. The fruit of the last is much used for culinary purposes in hot climates, eaten with animal and vegetable food and mixed with sauces, or with flour, and baked. The *Cayenne Pepper*, used in cooking, is the pod of a different species of capsicum, dried and reduced to powder, mixed with salt, and preserved in bottles. The species of this genus are numerous, but they all agree in their pungent properties, the smallest being most so. Their taste is very acrid, leaving a burning sensation, best removed by oil or butter. All are natives of tropical climates, where they form an important article of diet, and are used externally and internally for a torpid and paralytic condition of the organs. In small quantities it is a grateful stimulant. One of the varieties (*red pepper*) is cultivated here in gardens, and much used for culinary purposes. The *Guinea pepper* is an annual capsicum, the fruit of which is eaten green by peasants in the S. of Europe, and is preferred to the onion or garlic. It is valuable as a pickle, and when ground, as Cay-

enne pepper. Many of the pod peppers are imported pickled, or preserved here in bottles.

The Common Red Pepper (capsicum), much cultivated in our gardens, is a valuable spice. It requires a warm, rich and exposed soil. The seeds are planted in rows or hills 3 feet apart, and the plants hoed and watered occasionally. The seeds are preserved by running a string through the pods when picked, and placed in a dry place. It should be coarsely ground and eaten with fat and coarse animal food, cabbages, cucumbers and other cold vegetables. It is highly esteemed as a pickle and for the relief of flatulency, impaired digestion, giddiness, &c., taking 6 to 10 grains before breakfast, more especially when the stomach is torpid or vitiated.

PIMENTO, or ALLSPICE, *myrtus pimenta*—a native tree of S. America and W. Indies. That of commerce is chiefly imported from Jamaica. The tree is 30 feet high and very beautiful, abounding with white flowers in July and August, and exhaling a rich perfume. The leaves, when bruised, evolve an aromatic odor like that of the fruit, and by distillation a delicate oil which is often used as a substitute for that of cloves. It grows spontaneously on the northern coast of the above island. The plantations are formed by selecting a spot where they grow and cutting down all other trees and allowing them to decay on the soil. Young pimento plants spring up abundantly the following year, and the second year the land is cleared of all else than vigorous plants. In 7 years these attain their height. Few attempts to propagate the plant succeed.

The berries are picked while green, by hand, the small branches being gathered and the fruit picked from them. The berries are then spread on floors exposed to the sun for a week, or are kiln-dried, when they turn a reddish brown and are exported. A single tree has been known to yield 150 lbs. of the *raw* or 100 of the *dried* fruit. The plantations are very profitable, but an abundant harvest occurs once in 5 years. The fruit is sometimes called *Jamaica pepper*, but commonly *Allspice*, because its flavor resembles that of cloves and nutmegs. It has an aromatic and agreeable odor and taste. It is imported in bags of 1 cwt. each. G. Britain imported in 1840, 905,888 lbs. and the U. S. to the value of $121,545.

The composition of pimento is chiefly *volatile oil* 10, *green do.* 8, *astringent extract* 11, *lignin* 50, with *coloring matter, gum, water, &c.* Though used principally in cookery, yet it is taken for a relaxed condition of the stomach, and like cloves, to relieve flatulency, and with nauseous medicines, to prevent griping, &c., in doses of 10 grains to a drachm. The oil is obtained by distillation. The pimento oil of the shops is this and that of cloves. It is also used medicinally for the tooth-ache, and to correct tonic and purgative medicines—dose, 2 to 6 drops. From this is prepared the *water of pimento*, or from the bruised

seed, used as a carminative and stomachic. A spirituous solution is also used by physicians.

BETEL. A climbing plant of the E. Indies, of the pepper tribe. It is used in immense quantities in India, the leaves being chewed as we do tobacco, and it colors the lips and saliva a bright red and the teeth black; the latter color being preferred to the whiteness of the teeth of Europeans. It sweetens the breath and strengthens the stomach. It is carried about the person and presented by men and women, by way of compliment, as we do snuff, it being an offence not to partake of it. The roots of another kind yield an intoxicating juice called *ava*. These roots are bruised or crushed, and mixed with the saliva. The chiefs drink a pint of this juice at a time. With those not used to it, it causes giddiness and excoriates the mouth.



NUTMEG, *myristica moshata*, C. 22. O. 13. Pt. sp. 2-14. 30 ft. This is a beautiful and valuable tree, a native of the Moluccas, E. I. The well known fruit is a kernel surrounded by the spicy integument called *mace*, an extremely thick husk resembling in form a small peach; and the tree is not unlike our peach tree. When the fruit is ripe the husk opens, displaying a shell, like that of the filbert, within which is the nutmeg. The tree is ascended and the fruit picked from the husks. The nut is then dried in the sun, and afterwards over a slow fire. When the kernel shrinks and is heard to rattle, the shells are broken and the nutmegs taken out. These are then soaked in sea-water and lime, then heated, and afterwards assorted and packed for sale.

This spice is extensively used, and the amount imported is enormous. Distilled with water, or heated and pressed, they afford a large portion of essential oil. The *oil of mace* is like that of the nutmeg. The best oil is brought in jars from the E. Indies. The *mace* is dried and packed in bales for exportation. It has a very fragrant odor, with the virtues of the nutmeg for culinary and medicinal purposes. The fruit in Banda is often boiled and preserved in syrup, or pickled. The husk is likewise eaten stewed.

The tree is a native of the Moluccas, and was formerly monopolized by the Dutch, but it has been introduced into many other islands. 100,000 trees are growing on one plantation in Sumatra. It has also been introduced into Trinidad, W. Indies. The tree is raised from nurseries, where it remains till the 5th year; it then puts forth its flowers, and indicates its sex. The trees are then transplanted 30 ft. apart, in the form of a diamond, with a male tree in the centre. They commence bearing the 8th year, and continue to increase many years.

There is said to be no particular season for bearing, but every day exhibits new buds, blossoms and fruit in every stage of growth. The tree is very beautiful and productive, and is now cultivated chiefly by Europeans. The shell is of a glossy black; and the mace, seen when it bursts, is of a bright scarlet. Both tree and fruit are therefore among the most beautiful in the vegetable kingdom.

Nutmegs to the amount of 157,158 bushels, and 10,333 pounds of mace, were imported into G. Britain in 1840, and into the U. S. to the value of $122,603. They are packed in dry lime for exportation. 2 varieties are known, the *royal* and *green*. The former is the larger, and produces longer mace. The good nuts are large, round and heavy, of a light grey, and finely marbled. A pound of the kernels yields 3 ounces of fixed oil, which is a third of the weight of the nut. A transparent volatile oil is also obtained by distillation, which is 1-32d part of the weight of the nut employed. The nuts are often punctured and the oil boiled out before being offered for sale; but the fraud may be detected by the weight. One species yields fruit, the kernels of which afford an oil like suet or fat, which is used in medicine. Being attacked by an insect, the nut is smoke-dried for 2 or 3 months. When imported in the shell, they are secure from this insect. A wild nutmeg, oblong and 1¼ inches in length, is also imported in the shell.

The composition of the nutmeg is *volatile oil* 2.70, *reddish soft oil* 10-41, *white solid do.* 17-72, *gummy extract* 25, *ligneous fibre* 34-38, *resin* 3-42, &c. *Starch* is detected by iodine in both oils, and both yield volatile oil by distillation. It is on this latter oil that the activity of the nutmeg and mace depend. Their effects, when swallowed are like those of other spices. In large doses they are narcotic, producing giddiness, delirium and stupor. By their stimulant properties they serve to flavor food and drinks, and promote digestion; but food highly seasoned by them is injurious to the brain. They are frequently employed as a cordial and anti-acid in bowel complaints, taken to the extent of half a drachm in warm brandy and water. The oil of nutmeg is considerably used in medicine, often externally for rheumatism and palsy. The volatile oil, in proof spirits, is cordial and carminative. The grated nut is commonly used for flatulent colic, to relieve vomiting, &c; but with those of full habit it should be used cautiously.

Madagascar Nutmeg, C. 11, O. 1, sp. 9. Et. ft. 20. The leaf has a pleasant smell like cloves. It forms a large tree in Madagascar, with an aromatic bark, and heavy insipid wood. The dried fruit is very aromatic.

CINNAMON, C. 9. O. 1. Laurineæ, sp. 18-68. Et. 20 ft. The Cinnamon of commerce is the under-bark of the tree L. cinnamomum, found chiefly in the E. Indies. The branches of trees 3 years old are cut down in April and November, the outside scraped off, and the bark

loosened by slits, and then taken off entire, cut into slices and dried, when it curls up, the smaller pieces are then inserted in the larger ones, and packed for market, mainly in Ceylon and Malabar. Persons were employed to taste and chew it, to determine the several qualities; but the office can be performed only 2 or 3 days, as the cinnamon deprives the lips and tongue of all their mucous; the office is now abolished. The bundles, when packed, are 4 feet long, weighing 88 pounds each.

The offsets of the roots make the finest cinnamon. The tree is very common in Ceylon, and is used for fuel. From thence it has been introduced into the W. Indies, where it thrives well. The infusion of thin pieces in boiling water is a very agreeable liquid. An oil is extracted also, which is very valuable as a perfume, but cassia is much substituted for both the oil and bark. The *leaves*, the *fruit* and the *roots* of cinnamon likewise yield oil. That from the fruit is highly fragrant and gummy, and candles are made of it.

The fruit is the size of the pea, and is soft and insipid. The kernel germinates soon after falling. The wood is white, and the roots are thick and exude an abundance of camphor. There are many varieties, but only 4 are barked. The tree is good for nothing after 18 years old. It has been propagated by pigeons eating the fruit; but it is now raised by planting the berries. The bark is cordial and tonic, but is chiefly used to cover the nausea of other remedies. The oil from the leaves is called the *oil of cloves*, and that from the roots the *oil of camphor;* both are powerfully stimulating, and are used for cramps of the stomach, flatulent colic, hiccough, toothache and nervous languor. L. cassia is used like cinnamon, but is inferior to it. L. camphora is a species, from the roots and branches of which camphor is obtained.

92,000 pounds are said to be consumed annually by slaves in the mines of S. America, each receiving a small piece as a preservative against the effluvia of the mines.

The inner bark yields its fragrance to the outer by drying, when packed. A large and small harvest of the shoots are afforded annually, the first when the fruit is ripe in May and June, and the other in Nov., but on the government plantations there is but one.

Prior to 1766 it was supposed to be deprived of its virtues by cultivation, and was therefore collected only from forests. But the Dutch introduced its cultivation into Ceylon, which, at the time it was taken by the English, abounded with cinnamon plantations. Four or five gardens now yield more than 400,000 pounds; and 25,000 persons are employed in the cultivation of it. The Dutch monopolized the trade of the article, and made punishable with death the selling of a stick, the extraction of the oil, the injuring of a tree, or a connivance at any one of these things without the orders of governmental officers. To

secure their monopoly, all superabundant trees and oil were destroyed.

This plant was known to the Hebrews and noticed in Scripture 1490 years before Christ, they having received it from the Arabians. The trees are grown principally in Ceylon : the annual imports into the U. S. are $16,000. Cinnamon in chests and boxes is commonly small and inferior. Ceylon cinnamon, which is the best, is cut obliquely at the bottom; other kinds are cut transversely, and there are 1st, 2d, and 3d kinds of the Ceylon. The latter is thicker and darker, with a pungent but bitter taste. Beside the Ceylon there are the *Bombay*, *Malabar*, *Java* and *Cayenne*, which is most acrid and peppery. The *Cassia lignea*, substituted for cinnamon, is thicker, in shorter pieces and less delicate, but is of strong flavor. Many prefer it. Cinnamon is chiefly consumed by chocolate makers.

The composition of cinnamon is *volatile oil*, *tannin*, *mucilage*, *coloring matter*, *resin*, *acid* and *ligneous fibre*. The physiologic effects are like those of other spices. It stimulates the stomach, and promotes assimilation, but its repeated use induces costiveness. It is an agreeable condiment in cookery, and is added to medicines to improve their flavor, check griping, as a tonic and cordial, as an astringent in diarrhœa, with chalk, or vegetable infusions—in low fevers, flatulent and spasmodic affections of the alimentary canal, to check nausea and vomiting, and in uterine hemorrhage—dose, from 10 grains to half a drachm. The oil used in medicine is obtained by macerating the bark, reduced to grains, in sea water, and by distillation. Its elements, per centum, are carbon 81, hydrogen 7, oxygen 10. It is employed for paralysis of the tongue, cyncope and croup of the stomach, but principally with other medicines. *Cinnamon water*, *spirit of cinnamon* and *tincture and compound do. of cinnamon* are used as above. The *powder of cinnamon*, *aromatic confection* and *aromatic plaster* are also medicinal preparations. The last is used spread over the region of the stomach for dispepsia, to allay pain, nausea, &c. The confection is made of cinnamon, cloves, saffron, chalk and sugar, mixed with water, and used for diarrhœa, flatulency, &c.

CASSIA, or Wild Cinnamon, *laurus cassia*, C. 10. O. 1. Leguminosæ, sp. 56-149. A tree grown in the E. Indies and China, and well known to the ancients, as to moderns, for its spicy bark. It is inferior to cinnamon, a more recent knowledge of which has mostly excluded cassia. This being less expensive, however, it is much substituted for cinnamon, especially for the oil, which is sold for it. The *buds* are used in cookery and for other purposes, and imported from China. One species, *senna*, an Arabic name, is well known in medicine. Numerous species are found in S. America, some being shrubs and some trees.

Cassia lignea, or *China cinnamon*, and the *cassia buds* are imported

in chests and bundles from China and other places in the East. Vast quantities are brought to Canton from near *Kwei Lin Too*, the city of Cassia trees. A particular kind is said to be so much esteemed by the Chinese as to command $10 a pound, there. Another fine kind is met with, for which $100 is paid per *catty* (1⅓ lb.). These do not get abroad. The best is cut in the 3d or 4th moon, and the 2d sort in the 6th or 7th moon, and the buds in the 8th or 9th. *Malabar cassia lignea* is much inferior, and cinnamon is exported for it. Cassia buds resemble cloves, but are inferior in odor and flavor to cinnamon. 75,000 pounds are imported into G. Britain annually, and in 1830, 837,586 lbs. of cassia were imported; but in 1840, 64,000 pounds only. Cassia contains the same substances as cinnamon, and its effects are similar. The *oil of cassia*, *spirits* and *tincture*, are used medicinally.

GINGER, *Zingabar officinal*, a native plant of Asia and of S. America, or early introduced by the Spanish. It is largely imported from thence, as well as from the W. Indies. That from the latter is superior to the E. Indian. The roots, and as a dried preserve, are the forms in which it is imported. It is an annual with a perennial root. As imported it is *black* or *white;* but this difference depends on the mode of preparation. The tuberous roots are taken up when the stalks wither, and, for the black ginger, they are scalded in boiling water, and dried in the sun; but for the white, the best roots are taken, though not scalded, but cleanly scraped and carefully dried. This is the best, and bears the highest price. The root is dug young for preserves, washed in cold water, and peeled; then repeatedly washed, and put into jars and covered with weak syrup of sugar, which is replaced in a day or two by a stronger, and again replaced. The syrup is afterwards fermented into a cooling drink. It is cultivated in a similar manner to the potato. The properties of ginger will be spoken of under the head of medicinal plants.

CLOVE, *caryophyllatus arromaticus*, C.12, O.1. This is a celebrated tree 15 to 30 feet high, a native of the Molucca Islands, where the natives have made its fruit an article of profitable traffic from very early periods. 300 years ago Europeans were ignorant of its locality, although they have used it for 2000 years. Cloves were brought as merchandize from Persia, Arabia, and Egypt, to the Mediterranean ports, where they were purchased by the Venetians and Genoese. But, in 1511 the place of production was discovered by the Portuguese, who, soon afterwards, were driven from the Moluccas by the Dutch, who monopolized the trade. They are said to have destroyed the trees on all but one island; and then the natives were compelled to cultivate 125 trees on each of 4000 parcels of land; so that on this small island (Amboyna) there were 500,000 clove trees, each averaging annually 2 lbs. of cloves, and the whole more than a million lbs. But it has lately been cultivated on other islands, and even in the W. Indies.

The Clove tree resembles the bay tree; it is very beautiful, with

peach-blossom colored flowers in bunches. When the calyxes turn red, they, with the embryo seed, are beaten from the tree, dried in the sun and exported. Each berry contains one oval dark colored seed. The tree does not produce fruit till planted 8 years. All parts of it are aromatic, and the leaves are little less pungent than the calyx of the flowers. Planted along the avenues to a residence, they are very beautiful and fragrant.

A larger portion of essential oil is obtained from the clove than from any other plant; it is highly pungent and heavier than water. When the cloves are fresh the oil is obtained by pressure, but commonly by distillation. Those from which the oil has been taken are often fraudulently mixed with perfect ones; but they have a pale color, are without flavor, and shrivelled. The essential oil, therefore, constitutes the aroma and pungency of the fruit. But these properties are developed only in a favorable climate and situation; and hence its profitable growth is limited to a narrow range. The trees of parts of Asia and China possess little flavor. The tree absorbs so much moisture that no herbage will grow under it; and the cloves when gathered, if placed near water, absorb much of it, and are thereby much heavier. This is said to be turned to profitable account by dealers.

Cloves are imported in casks and bags. 93,549 lbs. paid duty in England in 1839, and the value of $47,518 was imported into the U. States in 1840. The name is derived from *clou*, the French word for *nail*, which the fruit resembles. It should have a fragrant odor and acrid taste; and when the nail is slightly pressed on the fruit it should give out oil. Those from the Moluccas are best. The *Bencoolon clove* is most esteemed. Cloves from Bourbon and Cayenne are least flavored. The clove stalks are used by distillers.

The Mother of Cloves is the fruit of a tree in the E. Indies; it has been an article of some commerce. It is of the shape of the clove, though smaller; and its odor and flavor are also similar, but much weaker.

The composition of cloves consists of volatile oil 18, tasteless resin 6, a peculiar tannin 13, extractive and gum 18, woody fibre 28, water 18. The infusion and oil of cloves suffer changes like those of opium, morphia and allspice, when acted on by nitric acid. The fruit is de void of the acridity and fiery taste of pepper and ginger. The principal use of cloves is for culinary purposes, though not in quantities to act as condimentary stimulants; still, they are useful gastric excitants in dispepsia, with a relaxed alimentary canal. They are usually employed in medicines to improve their flavor and correct their operation. Alone, they act as a stomachic and carminative, for flatulency, nausea and vomiting. A liquor called *cloves* is prepared from them by distillers. They may be taken in doses of 5 to 10 grains.

The infusion of Cloves by maceration, for 2 hours, in a vessel, lightly covered and strained, is used as above, and also for gout; ammonia increases its efficacy. The *oil of cloves* is obtained by repeated distillations with water. Cloves yield 17 to 22 per cent. of 2 oils, one lighter and the other heavier than water; the latter, in distillation, coming over first. In commerce, the 2 are mixed. The oil is soluble in alcohol, ether and pure vinegar. Part of the light oil is lost by rectification. The oil is often used in the hollow of a carious tooth to relieve pain and as an addition to purgatives, to check nausea and gripings—dose 2 to 6 drops. Much use is also made of it by distillers and soap-makers. The *tincture of cloves*, a very useful and elegant preparation, is prepared by maceration in rectified spirits for some days, and filtration. It is used in tonic mixtures, and for the above purposes. The *syrupus rhei aromaticus*, an important medical prescription, is made of rhubarb, bruised cloves and cinnamon, 2½ oz. each; bruised nutmeg, 2 drachms; diluted alcohol, 2 pints; syrup, 6 pints. Macerate the rhubarb and aromatics in the diluted alcohol for 14 days; strain and evaporate in a water bath to a pint, and while hot, mix with the hot syrup.

The *Cherry Capsicum*, or Bird Pepper, omitted under the head of Spices and of Peppers to which it belongs, is now much cultivated for making *Cayenne Pepper*, and the *Bell Pepper* is also cultivated for pickling or preparing Cayenne. For this purpose the green pods, being gathered when dry, are slit down on one side, the seeds taken out and laid in salt and water for 24 hours, changing the water after the first 12. They are then laid out to drain for 2 hours, when they are put into bottles or jars, and boiled in vinegar poured over them. The bottles being then closely stopped for a few weeks, they are fit for use, and are the best pickle known.

The Bird or Cherry pepper is the most acrid of all the varieties of Capsicums, but it requires the hot-bed to perfect it. The seeds are gathered when quite ripe, well dried in the sun, then ground, dried and put in bottles closely corked, and eaten with fish and meats. They may be cut off with the stalk at the roots, and tied in bunches, and hung in a dry place, where they will remain for a long time without injury.

The common, or annual capsicum, will answer, treated in the same way; and being more hardy, is generally cultivated for this purpose. The Bell, or heart-shaped, is best for pickling, producing fine large pods of a deep red color, when ripe. The yellow variety is mostly raised for ornament. Sorts with small oblong pods are the best. These are called the *Chilies*, coming as they do from Chili, and greatly cultivated for Cayenne pepper. All the species suitable for cultivation in our climate are raised from seed, sown in April, in hot beds, if practicable, and transplanted 3 or 4 inches apart, under glass, and

then planted out in a sheltered spot, in lines a foot a part and 6 inches from plant to plant. Large quantities are thus raised.

The annual capsicum commonly cultivated is here often called the *red pepper*, and the different varieties abovementioned as the *Cayenne pepper*, are the peppers in a prepared state, for which they are now much raised. They are usually eaten, coarsely ground, with cabbage, cucumbers, fish, and tough meats; and are taken medicinally in doses of 6 to 10 grains, in the morning, for flatulency, weak digestion, giddiness, &c., but only in marked cases.

The *Spices*, we have here concluded, are productions of plants growing (excepting the capsicums) exclusively in tropical climates. Their qualities are acrid and hot, and hence are called *peppers;* some are also aromatic, and are therefore called *spices;* these terms are, however, often applied indiscriminately. They are articles of luxury; and being of small bulk, were in ancient times, and still continue to be, articles of extensive commerce. They were much used by the ancients, together with myrrh and frankincense, both upon their altars and funeral piles. The Romans were profuse in the use of these most costly perfumes. More than a year's supply is said to have been lavished by Nero at the funeral of Poppæa, and the Sabeans of Arabia Felix, used no other fuel than that yielding the richest fragrance. That country abounds, indeed, with fragrant spices; and from this its name originated. Ceylon is also rich in aromatic plants. The price of spices is now within the reach of all, and hence their great consumption in this country and in Europe.

HERBACEOUS SEASONING PLANTS.

These, though important for their culinary uses, are not substantial articles of food; but they are employed for the flavor which they impart to other vegetable substances and to meats. Much taste and skill is exercised in the use of these in cooking. They have also been much employed for supposed medicinal virtues, and very many are now esteemed for these properties; they constitute, for these combined purposes, an essential article of cultivation in every kitchen garden. They are strictly aromatic and sweet small pot-herbs, possessing, with the foregoing, medicinal properties.

These plants belong chiefly to an order abounding in volatile oils, to which their flavor and perfume is owing, and which resides more in their stalks than in their flowers. Thyme, Mint, Sage, Majoram, Clary, Savory and Basil belong to this order, and also Rue, Tansey, Chamomile, &c. Parsley and Fennel are an exception to the commonly poisonous quality of the umbelliferous plants; they are, at least, innocent when eaten young, or before the flowers appear. The horse-radish, of the cruciferous order, the roots of which are highly pungent

and wholesome, and occasionally some mushrooms and the truffle, are used for seasoning. Some of these, it will be seen, we have arranged under other heads to which their chief characteristics entitle them, it being an important object with us in this work, to arrange all plants in the *natural order which their chief qualities indicate.*

THYME, *Thymus vulgaris*, C. 14. O. 1. Labiateæ, sp. 20-32, E. 1 ft. A name signifying courage or thought, from its supposed qualities in reviving the spirits, &c. It was anciently used in sacrifices on account of its fragrance. It grows wild in stony places in the S. of Europe, where, in some places, it is 6 feet high. In Greece it was well known for the excellence of the honey it afforded; and it is said that sheep eating of it afford the finest mutton, and deer the finest venison. Others say they do not eat it. It has an agreeable aromatic smell and a warm pungent taste. An infusion of it is used as a tonic for the stomach, for reviving the spirits and relieving the headache. Its principal use is for broths, soups and ragouts, and in stuffings to savour meats, &c. The lemon thyme is less pungent than the common garden kind, but is more grateful, and is used for seasoning veal, &c. Two varieties only are cultivated, and both from seeds. Thyme should be cut when in blossom, well dried in the shade, and hung up in paper bags. An essential oil from it, especially the calyx, is very acrid and pungent, and is sometimes used for culinary purposes. *Thymus serpyllum*, a variety, naturalized here, is of a milder flavor and more grateful than the common thyme. T. vulgaris has the aroma common to lavender, sage and rosemary. It yields a species of camphor by distillation with water. It is put in with pickled olives, but it would not answer well with pickled cucumbers. It is known here as a low shrubby evergreen. The *broad*, *narrow* and *variegated* leaved are commonly cultivated. The *lemon* thyme is a smaller trailing evergreen thriving in dry soil. All sorts are propagated by seeds. It was employed by the Romans to give flavor to cheese. The young leaves and tops are the parts used. It is sown early in spring on a bed or in drills, 6 inches apart, and cultivated like sage, &c. It will not thrive on stiff moist soil. The cuttings and slips of the young branches, planted in the spring in a shady place, grow readily. Seven species are common, one being the *Virginia* thyme.

SAVORY, *Satureia*, C. 14. O. 1. sp. 10-17. A. 1½ ft.—to cram or satisfy. It is in much use for seasoning soups, broths and stewed meats. There are two varieties cultivated, both from the S. of Europe. The *Winter* (S. montana) is a perennial, hardy and shrubby, and the *Summer* (S. hortensis) is a hardy annual. They have a hot aromatic and penetrating taste, and are an excellent seasoning for farinacious food, as peas, beans, &c., preventing wind in the stomach. It was formerly used in cakes. The winter or everlasting savory is propagated from seeds or slips, and summer savory from seeds only. The

first has white flowers in May and June, and the second in June and July. They are grown in any soil; the winter is best on barren soil. Their pungent leaves are much esteemed in salads, and they have been much used to attenuate viscid humors, dispel flatulency, and to increase appetite. Dried and put into a bed, they expel fleas. Being sown, the plants are thinned to 5 or 6 inches, and cut as wanted; but they do not produce a succession. For drying, the whole plant is pulled, the extreme roots are cut off, and the plant preserved as other herbs, for winter's use. The slips of the winter savory are planted in spring and taken up in autumn and transplanted into beds or rows a foot apart. They should be kept clear of weeds. There are four species well known.—Flower stalks axillary, in scymes turned one way; leaves linear, lanceolate, entire, with sharp points.

STOCK, *mathiola*, C. 15, cruciferæ, sp. 11-26, ft. 2. Herbs covered with a soft white down; and the leaves of all the species are used as pot-herbs or salads. The Gilliflowers are of this species.

MINTS, *mentha*, C. 14, O. 1, Labiateæ, sp. 35-43, Dh. P. 1-2 ft. A name given for the supposed virtues of the plant. The green, or *spearmint*, (M. viridis) the sort used for culinary and most other purposes, is more agreeably flavored than the peppermint. It is eaten with vinegar and sugar as sauce with lamb, and is used in spring salads; and when dried, in soups. Its scent is very refreshing, and the leaves are excellent as a warm stomachic in producing appetite, and in allaying pains of the bowels; it also stops crude retchings or vomiting, if not from inflammation. It grows in abundance near moist places in the U. S., and is gathered by most families in the country and put in papers or bottles. With vinegar it stops the hiccough, and with sugar it makes a grateful conserve. An essential oil is distilled from it, and also a distilled water, a spirit, and a tincture. In drying, the leaves loose much of their weight, but not their taste or smell.

Peppermint (mentha piperita) is the strongest and most aromatic of all the mints, and is most used in medicine. Distilled in water, it yields an essential oil of considerable value. *Peppermint water* is made and sold extensively. *Pennyroyal mint* (mentha pulegium) is one of the varieties much used as an herb medicinally. There are 60 species of mints, 3 or 4 of which inhabit the U. S. They are cut for drying when in flower, in dry weather. Mint was celebrated in remote antiquity, both in Mythology and for its useful qualities. They partake of the tonic and stimulating properties which distinguish all labiate plants, in an unusual degree.

The poets feined that *Mintha* was transformed into this plant. Mint is said to prevent the coagulation of milk, and is therefore recommended to be used with milk diets, and even as cataplasms and fomentations for resolving coagulated milk in the breasts. Dry mint digested

in rectified spirits appears a dark green by daylight and a bright red by candle light. Spearmint is cut just as the flowers appear, for medicinal purposes, but for the oil the flowering plant is preferred, and both are cut in dry weather. The roots must be transplanted every 3 years to preserve its qualities, otherwise it degenerates into spearmint. They, with most labiate plants, give fragrance to the air and correct the effluviæ of stagnant pools. Plants set in spring come into use the same year. To preserve it best, dry it quickly before the fire in a screen, powder it immediately, and put in tight bottles. Parsley, sage, thyme, &c., should be thus preserved.

M. Piperita has the most penetrating smell and stronger and more pungent taste, for medicinal purposes, (see medicinal plants.) Ten species are well known.

Peppermint cordial is made of 75 drops of the oil, 1 oz. sugar, with 10 pints of rectified spirits of wine, diluted with 10 galls. of water, and 3 drachms of alum. The addition of 6 oz. of salt to 10 galls. of water greatly improves the flavor and strength of any spirits.

SAGE, *Salvia officinalis*, C. 2. O. 1. Labiateæ, sp. 95-170. Eh. A. and P. The common species is from the French *sage* (wise), and the genus from *to save*, both in allusion to its virtues. All are of easy culture, and some are ornamental. Of the S. officinalis there are many varieties. It has been in great repute in medicine as a sudorific, aromatic, astringent and antiseptic. The Chinese use it as a tonic to strengthen the nervous system, preferring it to their own tea. It is also given with us as a warm tea, to promote perspiration in colds and fevers. With food it is principally used for seasoning soups and broths, and for stuffing ducks, geese, turkeys, sausages, &c. It is likewise much used in making *sage cheese*. It is discarded from the English materia medica. The S. grandiflora is prepared for tea. Some species produce galls or apples, by the junction of onion seed, and are sold in the Greek markets, and are candied with sugar. S. verbenaca is a native of the four continents, and everywhere very aromatic. A mucilage is produced from the seeds, which, if placed under the eyelids, has been said to abstract any dust, &c., which may have got there. The flowers are used in Holland to give flavor to the Rhenish wines. A wine is made with sugar, from the herb or flower, not unlike frontinac. There are 3 or 4 varieties commonly cultivated, all sown or raised by suckers on light soils for 3 years. The garden sage is highly stimulent, tonic and stomachic, resembling camphor, which it contains. There are many species, natives of this country.

The *red, broad-leafed*, or balsamic, *green, small-leafed green*, or sage of virtue are cultivated. The *red* is most in use; the 2d is used medicinally, and the 4th is best raw and for decoctions. They are propagated by seed suckers or portions of old roots. They grow on any soil for 3 or 4 years. 35 species are well known; the genus is indeed very

numerous.—S. officinalis; leaves lance-shaped, crenate, dull green or purplish; corolla blue.

MARJORAM, *Origanum*. C. 14. O. 1. Labiateæ, sp. 14-24. Es. 1 ft.—from *joy*, &c. Two varieties only are used for culinary purposes. The *pot marjoram*, a hardy plant, is used as a seasoning for soups. The *sweet knotted* is a native of Cyprus and the S. of Europe. The sweet has a pleasant smell and warm aromatic taste, and is used also for soups. It corrects flatulency, and is serviceable for nervous complaints. Both are dried and put up in papers. The O. vulgaris is ornamental and aromatic, and is very grateful in tea and for fomentations. It grows wild in thickets and hedges. The essential oil is so acrid as to be used as a caustic by farriers. A little cotton moistened with it and put into a decayed tooth often relieves the pain. The tops are used in the country to dye cloth purple. The cloth is macerated in alum-water and dried, then soaked 2 days in a decoction of the bark of the crab tree, then wrung out, boiled in a lye of ashes, and then boiled in a decoction of the marjoram. Sheep eat it, but horses and kine do not. It is retained in the Materia Medica as a tonic and stomachic. Some use it powdered in cephalic snuffs. The seed is mostly from Italy, as it ripens seldom in northern climates. The winter marjoram, being most aromatic, is preferred. A sheltered situation is most favorable for its growth; the other is a biennial, and is renewed annually by seed; while the pot-marjoram is perennial, propagated by cuttings or parting the roots into small tufts and planting in the spring in small beds or borders, in rows. It is cut when in flower, for dying.

MARYGOLD, *Calendula*, C. 19. O. 4. Compositeæ, sp. 10-24. A. 2 ft. A native of the S. of Europe. Many medical virtues have been attributed to this plant. It is used in the form of tea, and is given in agues. The plants are boiled in broths and soups. In Holland they are extensively sold for these purposes. The leaves are gathered when dry, and put up in papers for use. The flowers are open from 9, A. M. till 3, P. M. The flowers of C. officinalis afford a distilled water, a kind of vinegar and conserve. The species are common in this country.

The soil should be light and sandy. The marygold requires little culture, as it propagates itself for years, but the flowers are not so large as by annual sowings. Sow the seed in April in a bed, and thin to 6 or 8 inches. Keep out weeds, and transplant, if desired, when in flower; gather in a dry day, take off the outer leaves, spread on a cloth in a dry room, turn, and then put them up for use. There are 7 species well known.—C. officinalis; seeds boat-form; leaves sessile, lower spoon-shaped, upper lanceolate; flowers deep yellow.

CHERVIL, *scandix cerefolium*, C. 5, O. 2, sp. 11, A. 1¼ ft. A plant of warm aromatic qualities from the S. of Europe. When young it resembles parsley, but afterwards, hemlock. The tender leaves are

used in soups and salads. A soup is seldom served by the French and Dutch without chervil as a part. It is thought to be a more mild seasoning than parsley, so common with our cooks. A writer said 200 years ago, "chervil should be eaten with oil and vinegar, being first boiled, which is very good for old people that are dull and without courage: it rejoiceth and comforteth the heart and increaseth the strength." There are two varieties, the *plain* and the *curled*, differing little in quality; the latter is principally cultivated; the former has poisonous roots, and the stems and leaves dye a beautiful green, and the umbels a yellow. It is found wild only, on fertile soils. A successive supply of the latter is obtained by sowing in Feb. and Aug. in shallow drills, 8 inches apart, and covered lightly; it is also sown broad-cast, raked in and thinned. Sown in Aug., in beds, it is used throughout the winter, if protected. The leaves, 3 or 4 inches long, are cut close, when they are followed by others. The rest of the species are weeds.—Umbels sessile; flowers white; leaves triply pinnate; herb pale, sweet scented.

BASIL, *bassilicum ocymum*, C. 14, O. 1, Labiatæ, sp. 20-50, A. 1-3 ft. It derives its name from the strong scent, or from *quickly*, owing to its rapid growth. It is of E. India origin. Two varieties are cultivated here. The *sweet*, or *large leaf*, is principally raised for the table. Though introduced in 1573, it has not been long used. It enters into all the soups and sauces of the French. The leaves, the part used, have a strong flavor, like cloves, and are excellent for seasoning dishes, mock turtle soup, or as a salad. They are tender; and tied in bunches and hung in a dry room, they keep well. They have been used in medicine. Both sorts (*common sweet* and *bush*) are raised from seed sown on a prepared bed in April, transplanted into warm light soil, in rows 6 or 8 inches apart each way, and watered occasionally. They are tender plants, and should be pulled, tied and hung up before frosts.—Leaves ovate smooth, calyx fringed, stem hairy, 3 ft. high; flowers white and violet, small, in bunches, terminal.

BORAGE, *borago officinalis*, C. 5, O. 1, Borragineæ, sp. 4-7, A. 3 ft. It is brought from Aleppo, and formerly supposed to have cordial virtues. The tender leaves are used as a pot-herb in Italy, and the flowers in France as an ornament. In a beverage of wine, with water, sugar and lemon juice, it gives an additional coolness. The young leaves are used as a pot-herb or salad. The plants of this tribe are harmless and inert; their prevailing constituent is mucilage; nitre is also found in some species. Its coloring principle is employed to color unguents and oils, as lip salve and hair oil. Two species only are much known. B. O. is now mostly used as an ingredient in summer drinks, called "cool tankard."

OKRA, *Gombo, hibiscus esculentus*, is much used in soups and stews, imparting a rich flavor and considered nutritious. The green cap-

sules are used for this purpose, and the seeds, if burnt and ground like coffee, can hardly be distinguished from it. The seed is planted in May (if warm and dry) in drills an inch deep and 3 or 4 feet apart; thin and earth them 2 or 3 times.

HYSSOP, is a warm aromatic plant, and the leaves and flowers have a pungent taste. When reduced to powder, these are used with cold salad herbs. This, as well as many preceding plants, is used medicinally, but these properties will be hereafter considered.

Blessed Thistle, Camomile, Fever-Few, Fenugreek, Horehound, Lavender, Marsh-Mallow, Penny-Royal Mint, Rosemary, Rue, Tansy, Tea-Sage, Wormwood, &c., will be found described under medicinal plants, in another volume.

PLANTS DISTINGUISHED FOR THEIR AROMATIC SEEDS, ETC.

These are the products of a large number of plants, which are thereby rendered important for their dietetical and medicinal uses. They are chiefly members of the umbelliferous class, and are distinguished by the volatile oil they contain. In this respect they rank with many of the salads of which we have spoken, together with the parsnip, skirret, &c. Many of the umbelliferous plants, as we have said, are poisonous, or are acro-narcotics, causing, when swallowed, irritation, giddiness, delirium coma, convulsions, &c. The active properties, taste and smell, are seen to be similar in most of the seeds of these plants; and, unlike the salad plants described, it is for these seeds, and their peculiar properties only, that they are distinguished. Many of these will be described under the head of medicinal plants, where, but for the culinary purposes to which they are applied, we should have placed them. The character of the plants of this class are, however, extremely variable.

ANISE, *Pimpinella Anisum*, C. 5. O. 2. Umbelliferæ, sp. 7-9. A. Ds. 1 ft. Cultivated in Malta, Spain and Germany, from whence the seeds are chiefly imported for medicinal use. 192 cwt. were imported into England in 1839. The seeds are aromatic and carminative; they yield an oil by expression and distillation with water, which is much used in flatulency in children, to prevent griping, as are the seeds. The oil is used for scenting poisonous baits and to obliterate other smells. Anise is sown in gardens for the leaves, which are used for garnishes, for seasoning, &c., like fennel. The seeds are used in cordials, with equal parts of angelica, also to flavor liquors, cakes and plumbs, ragouts, confectionary, &c. It is composed of *volatile oil* 3, *stearin, resin, fatty oil* 3, *phytocol* 7, *uncrystalizable sugar, gum* 6, *extractive ulmin* 8, *gumoin* 2, *lignin* 32, *with several salts* 8, *silicic-acid and oxide of iron* 3, *and water* 23. It is an aromatic stimulent, like dill. It is detected in the excretions of those taking it, particu-

larly the urine, which, with the milk, it is said to promote. Pigeons are said to be killed by the oil of the seeds. It has been used for pulmonary affections and for horse medicines. The oil is soluble in alcohol, but exposed to air it forms resin. It is composed of 2 volatile oils, one solid and the other liquid. Dose 5 to 15 grains, dropped on sugar.

The spirit of anise is obtained from the bruised anise and angelica seeds; macerate 24 hours and distil a gall. This, sweetened, is stimulant, stomachic and carminative. *Anise water* is commonly used. It is propagated by sowing the seed in spring on light dry soil.

Anise seed Cordial is made of 2 pounds of bruised seed, 12 gallons of proof spirits and 1 gallon of water. Distil off 10 gallons of cordial, and sweeten—or these proportions.

CARAWAY, *Carum*, C. 5. O. 2. D. A. 2 ft. It is cultivated as an agricultural and horticultural plant; in the first case for the seeds, which are used to flavor cakes, to form sugar-plumbs, and to flavor spirits, and also for a carminative distilled water. The seeds have a pleasant spicy smell and aromatic taste. Incrusted with sugar, they form the *Caraway Comfits;* they are likewise used in medicine, in cakes, and to flavor liquor, &c. An oil is extracted from them, and the leaves are used in soups and boiled with herbs, or as salads. The roots make a good pickle; and boiled, they are considered superior in flavor to parsnips. The plant grows wild in meadows and pastures, and is perfected the 2d year. It is cut in July, and thrashed on cloths in the field, and dried. Much is imported from Germany. England imports annually 500 cwt., though producing large quantities. The aromatic qualities depend on a volatile oil. It is given for flatulent cholic, to prevent griping, &c. in children, and is much used in many medical compounds. It is added to cathartic pills and powders—dose 1 to 2 drops. The *oil, spirits*, or *water* is generally used. The oil is obtained by distilling the bruised seed with water, yielding about 5 per cent. Carbon 86, hydrogen 10, oxygen 3, are its elements.

CORIANDER, *Coriandum Savitum*, C. 5. O. 2. Umbelliferæ, sp. 2-3. A. 2 ft. The leaves are strongly scented, and the seeds are aromatic and used to cover the taste of senna, and in spices as *currie powders*, and seasoning for puddings; covered with sugar, also as a sweet meat. They are sometimes steeped in wine or vinegar, and then dried, to render them milder. They are used in various confections, for distillation, &c. They are pleasant, warm and aromatic. The plant is cut in July and thrashed on a cloth. It chokes the wheat crop in some places. The seeds are aromatic stimulent, like other carminative umbelliferous fruits. They are thought equally as powerful a corrective with senna as anise, and were formerly a constituent of the compound infusion of senna, though ginger is now substituted for it. They are now employed chiefly as an adjuvant and corregent in medicines.

Like other seeds before mentioned, its properties depend on its volatile oil. The plant is hardy, and is propagated from the seed sown in autum in open situations, on a bed of fresh soil. It is a native of the S. of Europe.

CUMIN, *lagœcia cuminoides*, C. 5. O. 1. sp. 1. A. 1 ft. A native of Syria, and cultivated in Europe and some here, for the seeds, which are imported from Sicily and Malta. They have a warm and bitter taste, and contain a large quantity of essential oil possessing a carminative and stomachic power. The Dutch put them into bread, and the Germans into their cheese. The seeds are sown in autumn. The officinal cumin is most used medicinally. It is often mentioned in scripture. The odor is strong and aromatic. Its properties reside in a volatile oil, obtained by distillation with water. It is mostly used in veterinary surgery.

DILL, *anethum graveolens*, C. 5, O. 2, Umbelliferæ, sp. 4, Dh. A. 3 ft. This plant grows wild in this country and in Europe, produced by seed on light soil. The seeds have a warm pungent taste and an aromatic smell; they have been much used in medicine, and are now put in pickles to heighten their flavor, especially those of cucumbers. They are carminative, and are much used in making gin. Dill resembles fennel, but its odor is less agreeable. It is used to relieve flatulency and griping, and is thus used by physicians. The fruit is given to adults in doses of 10 grains to a drachm. The oil is obtained by distillation with water; its taste is sweetish, hot and penetrating. Dill-water is carminative, and is given to infants with food. It grows spontaneously for years, after sowing in some corner patch. This seed is meant instead of *anise* in the N. Testament, (Matt.)

COMMON JASMINE, *Jasminum officinale*, C. 2, O. 1, Jasmineæ, sp. 18-40, Dc. 1-5 ft. with white flowers, is a native of the East. There are 30 species. It is highly ornamental, summer and winter, trained against a wall. The flowers exhale a sweet and penetrating odor, from which a grateful perfume is made by soaking cotton in a scentless vegetable oil, and placing this alternately with layers of flowers in glass vessels. In a few days they give all their fragrance to the cotton, which is separated and the oil pressed out into small glass bottles. J. sambac is the species of the most exquisite fragrance, formerly so much esteemed in England as to be placed under guard. J. hirsutum is a tall tree, the sweet scented flowers opening during the night and fading at sun-rise. All the species thrive in light loam and peat.

MISCELLANEOUS EDIBLE PLANTS.

Among these are many which we have omitted to notice because they fall under no specific head, or are particularly described in the second volume under the heads of *Fruits* or *Medicinal plants*. Of this

number is *Rhubarb*. The importance of this plant as an esculent, however, may render it necessary to speak of its culinary uses and culture, reserving for the chapter and class of medicinal plants, as we have done with many others, a notice of its properties, particularly of the *Rheum palmatum*. Very many also of the *fruits*, which constitute important articles of food, are thus arranged under the general head of *Fruit, Pickles, &c.*, which, with the other important divisions in the next volume, it will be necessary for the reader to consult in order to complete his view of the "*Vegetable Kingdom.*"

RHUBARB, *Rheum*, C. 9, O. 3. There are several species of this valuable plant in cultivation, which are mostly natives of Asia. For fruit in spring tarts, the petioles of rhubarb are a good substitute; and they are much cultivated for this purpose. *The Monk Rhubarb*, R. rhaponticum, is likewise considerably cultivated. The *Hybrid Rhubarb*, R. hybridum, is now the variety in general use as a culinary vegetable, and cultivated in our gardens. The leaves are much longer and greener than the other, being often 4 feet in length. One has been known to weigh 4 lbs.; its circumference was 21 feet 3 inches, and its diameter 3 feet 10 inches; the length of leaf, with the petiole, 5 feet 2 inches. The stalks are also more succulent than those of the other, and hence more cultivated. The Buck's Rh. and Elford Rh. are, however, thought of finer flavor.

The plant requires much room, but it furnishes the material for more tarts than the apple or gooseberry, the branches of which occupy the same space. It comes into use in the garden in the spring, when no fresh fruit is to be had, and is therefore a profitable plant. It has been held in the highest estimation for centuries, both for its medicinal and culinary uses. It makes one of the most cooling, wholesome and delicious tarts served upon the table. For this purpose it is served alone, or cut up with acid fruits—with apples before attaining its flavor, and with gooseberries after losing it by keeping. As a tart, for puddings, pies, or alone, baked whole in a dish, no plant is more to be recommended for garden cultivation for its useful and wholesome properties.

Rhubarb is raised from seed. If these are sown in the spring the plants are planted out in autumn, and are ready for use the next spring; after which they last for many years. Each plant requires 2 to 3 feet of space. It requires a light, rich loamy soil, not too dry nor too moist, but deep. The seed is sown thinly in beds in April, and covered half an inch. When fairly up, they are thinned to 7 or 8 inches, and hoed till planted out in autumn, in rich manured ground, 4 feet apart; or in the *quincunx* order, which is best. The weeds are then kept out, and a dressing of manure put on in spring.

The stalks should be taken off at the crown of the roots. When forced in the open ground, large pots are put over the roots and cov-

ered with fermented manure, and larger ones, or barrels substituted when the plants are too large. They are covered nights, if cold or unfavorable, with mats. Covering the roots 6 inches thick may alone suffice to bring them 2 weeks forward of those in open ground. Plants of 1 or 2 years old are used for forcing in pots, which are supplied with water and placed in the hot-house, or vinery; and, when the plants have done yielding stalks, they are placed out in rich ground, and taken up again the next year for the same treatment. Hotbeds, frames, or pits, will do well for forcing this plant. The advantages of blanching it are the improvement of its flavor and appearance, and the saving of sugar in its preparation.

The true Rhubarb is grown principally in China, from whence it is much exported by Jews and Turks, who monopolize most of the trade. The R. palmatum approaches nearest to the China plant, and this is mostly used in medicine. Of this and the medicinal uses of Rhubarb generally, we shall speak at length hereafter. There are 10 varieties in use, but 6 kinds only are generally known, viz. *Russian*, *Dutch-Trimmed*, *Chinese*, *Himalayan*, *French* and *English*. The *Turkey Rhubarb* is imported from Russia; not from *Turkey*, as its name implies. It is supplied by merchants from a frontier town of China in exchange for furs, and is collected on the mountains of Tartary. 38,948 lbs. were imported into G. Britain in 1840.

Rhubarb is composed of *bitter principle* 14·375, *yellow coloring matter* 9·166, *astringent extractive* 16·458, *mucillage* 8·333, *extract by potash ley* 30·416, woody fibre 15·416, with several acids, salts of lime and potash, with water, gum, &c., the nature and effects of which will be explained in the next volume.

CABBAGE PALM, C. 21. O. 7. *Areca oleracea* is a large tree, 7 feet in circumference, of the West Indies. The stem is hard and is divided into short joints, and runs naked to the top, with a pith in its centre like that of the elder. Its leaflets are 3 feet in length, tapering to a point, and decreasing in size as they extend to the ends of the branches, presenting a very beautiful appearance waving in the wind. Its seeds are in small oval nuts hanging from the centre of the branches like a bunch of grapes. At the top of the tree, within the leaves, is concealed the *cabbage*. This is cylindrical, 2 or 3 feet long, and 3 or 4 inches thick. It is composed of compact scales like ribbons, forming a crisp and hard substance. In flavor it resembles the almond, and is yet more tender and delicious. It is commonly eaten like the cauliflower, cut in pieces, and fried or boiled with meat, or raw with pepper and vinegar, like cabbage-slaw. To procure this delicacy the whole tree is cut down. A black beetle is found in the cavity from which the cabbage is removed, where it deposits its spawn, forming the grubs called the *palm tree-worms*, which are eaten as a great delicacy. They are of a yellow color, with a black head, of the size and

thickness of the thumb, and very fat; and though disgusting to the sight, are regularly sold and considered a delicious treat. They are dressed by frying in a pan with salt and butter, or by roasting them on a skewer. They are said to partake of all the spices of India in taste.

THE CANE TREE of S. America is a valuable and curious tree, from which the natives of the Cordilleras obtain a supply of rich *milk*. It grows beside dry rocks and on dry rocky soil. Not a shower during many months of the year, moistens its foliage, and its branches appear withered; but from its stems, when pierced, flows a sweet and nutritious milk, most abundant at early dawn, affording a plentiful aliment to the natives and slaves, who gather around it with wooden dishes to catch the wholesome beverage. An abundant meal is made at the tree, or the overflowing vessels are taken home to supply the families.

EDIBLE FUNGI.

All the fungous plants belong to the 24th class of Linnæus, and constitute the cryptogamous plants. Many of these are the most remarkable productions of the vegetable kingdom. Their peculiar organization and functions have given rise to much discussion among physiologists and botanists. By some they are classed with animals, and by others with minerals; others, again, would exclude them from both these and the vegetable kingdoms, and give them an intermediate place. But they are now generally believed to be vegetable productions; and although they yield, when analyzed, the odor and elements of animal matter, they have the habits of vegetables. These elements, it might be supposed, from their analogy with those composing animals, should be wholesome and nutritive, but they are singularly the reverse from this, and are, withal, the most indigestible of food. All of them, in certain situations, are poisonous, and but few are edible under particular circumstances. A remarkable difference also exists between them and most other poisonous plants, as their poison is not dissipated by boiling or distillation.

Another peculiarity of these plants is that they are the common attendants of animal and vegetable decomposition, as witnessed in the diseases of grains, &c. Their minute seeds, undetected even by the microscope, infest the fluids and vessels, and perhaps the solids of animals and plants, and start into activity the moment the vital principle ceases. These, consequently, abound in low marshy and shady places, where vegetation is most luxuriant, and especially in autumn, when vegetables are in a state of decay, and during rainy weather.

But notwithstanding the poisonous character of these plants generally, some are edible, and are even considered by some an article of great luxury. The taste, however, which dictates their consumption

as an article of food, we could never reconcile with prudence or good sense, since other substances far more nutritive and wholesome, not to say more palatable to the majority of mankind, are more common. Few indeed are eaten in this country. Those not deemed poisonous grow in the open country, though whenever these are found in or near stagnant water and among decayed plants, they are invariably poisonous. The edible plants are *mushrooms*, *trufles*, the *morel*, &c. But many others are also eaten in Russia and some other countries.

Some of the poisonous fungi are found to contain the peculiar substances *fungin* and *boletic acid*, and some are supposed to contain *prussic acid*. Some yield spontaneously oxalic acid. It is thought that the nutritive principle resides in the fungin, and that the acid constitutes the poison. The former yields by distillation a brown oil, amonia, charcoal and water, and when burned it smells like bread. The charcoal contains several earthy salts, and all the species are similarly constituted, showing their analogy, in composition, to animal matter. When in a putrifying state, they also give out, at first, an odor like decaying vegetables, and then like putrid animal matter. The boletic acid tastes like cream of tartar.

The manner in which these plants are propagated is not less remarkable than their nature and habits. Their minute germs remain for a long time in the earth, or in vegetables, and even pass through the digestive organs, and sustain great heat, without injury, as in the case of paste made with flower; which, when in a putrifying state, is seen to be covered with fungi. The fungi themselves, when in a state of decay, are also attacked by other fungi. The membranes of the lungs have been found covered with mould or fungous plants. The fungi spring up with great quickness; even in a night. But we have noticed in the 1st part of this work many peculiarities of these plants, as the reader will have perceived.

MUSHROOMS, *agaricus*, C. 24, O. 9, sp. 308-715. These comprehend many edible fungi cultivated in England, but little regarded in this country. They are members of the most extensive genus in the vegetable kingdom. Much has been said of the mushroom tribe, but as they are little eaten with us, little need be said of them here. Some of the fungi are used in making a well known catsup; and, stewed with rich gravies, are thus thought delicious. The mushrooms are much cultivated in England and some other parts, and are deemed a luxury. When gathered in the field, great care is to be taken in not collecting poisonous ones. The *Field mushroom* is the only one much cultivated. The stem of this is short and white, having a prominent ring a little below the cap, covering the gills in early growth. The flesh is white and firm. The gills are at first red, but change when the cap alters its form. The upper surface also changes, which distinguishes it from the *toad stool*.

The common mushrooms vary in size and appearance. Some have measured 30 inches in circumference, and weighed over a pound. They are chiefly used to give flavor to ragouts. The *button*, or fleshy part, only is used, the stem, gill and skin being discarded. Being laid in salt, a juice is obtained which is boiled with spices, and this forms the catsup sauce. Mushrooms usually grow in rich old pastures, and are gathered in Sept. They are sometimes found among potatoes, and in places where they are little expected. It would not seem necessary to sow their seed, as they appear to exist in most places, and to germinate whenever circumstances are favorable, and oftentimes in large quantities. But, for a regular supply, they are cultivated in gardens, from the seed or spawn, though the wild ones are considered best. The spawn is a white fibrous substance which exudes, in short threads, from the plant. This is scattered on beds prepared with stable manure, and cultivated with care. There are 10 or 12 species considered esculent by botanists.

The champignon, agaricus protensis, has a stem like the A. campestris and A. auruntiacus, just described; but it grows on moister soil, and is therefore more suspicious. It resembles also the poisonous toad stool (*agaricus virosus*) on the upper part. All the mushrooms so nearly resemble each other that persons should be very cautious in eating them. If the smell be nauseous, they should be rejected.

A curious species (*boletus*) is eaten in Italy, which is *raised from stone;* one being a lime stone, found in chalk formations, and the other a solid turf from volcanic mountains. These stones are put into a cellar and constantly bathed with water in which the boletus has been washed, when they produce the fungus, which is eaten. One species is produced from bruised fragments of mushrooms; another from the husks of the bay-tree berries, another from the refuse of olive-oil presses. In France, the *boletus edulis* is raised by keeping the earth under oak trees moist with the water in which the plant has been boiled. This is said to taste like the cocoa-nut. One of the largest and most beautiful of the agaric tribe is used in the north of Asia to promote intoxication, having the same effects as ardent spirits. It is the favorite drug, *moucho-more*, used in Russia to intoxicate. The fungi are gathered in hot weather, and dried for this purpose. It is taken rolled up like a bolus and swallowed without chewing. When eaten fresh in soups it is not so intoxicating. One or two small fungi produce pleasant intoxication for a whole day; and if water be drunk after it, the narcotic effects are increased. The giddiness and drunkenness are like those produced by spirits. At first the recipient is cheerful and very active and talkative, and the effects are often ludicrous; so that in jumping over a stone, the person leaps as if to go over a fence. A talkative person withholds no secret, and others sing continually.

THE TRUFFLE, *tuber cibarium*, C. 24. O. 9. T. 1. sp. 26. This is a highly flavored tuberous root growing wild in parts of Europe, and esteemed as a great dainty, sliced and fried in oil, salt and pepper, or well stewed. It is much sought for, and rooted up by swine, which, with dogs, are trained to hunt for them in England and Italy; and it is mentioned that a man has possessed the power to scent them. They are very nourishing, and of an agreeable taste and smell, when ripe; they are also strongly stimulating, and aphrodisiacal. They are eaten raw or roasted in ashes, or thinly sliced and soaked in wine, and are used like mushrooms in seasoned dishes.

The form of the truffle is sperical without roots, of a dark color when old, and studded with tubercles. The interior is firm with capsules, as seen with a microscope, in which are 3 or 4 seeds. It grows in clusters a few inches under the ground, which is composed of clay and sand. Truffles are most abundant in Italy, where they often weigh from 8 to 14 pounds. Their place of growth is not known by any external appearance of the surface, hence the use of the truffle dog and pig to obtain them. The former is trained by much pains to scent them; and, on finding them, to bark and scratch the ground. The truffle is considered the best of the edible fungi, but it has not yet been propagated by culture. There are several varieties.

THE MORREL, *phallus esculentus*. This is a fungus of a round and hollow form, and of a yellowish color; it grows on a white smooth stalk 4 or 5 inches high. It is found in moist woods and pastures, and is in perfection in June. Its substance is friable and wax-like; and it is used like the truffle, as food. It is said to be found growing most luxuriantly on spots where charcoal has been made. It is cultivated and raised from seed. It is indigenous to G. Britain, parts of the continent, and probably to the U. States.

LICHENS, C. 24, O. 8, are of several kinds, growing on rocks, trees, &c., and used as food, variously prepared, by people on the sea coast, and also as medicines, dyes, &c. There are 1200 known species of lichens, but only a few varieties are eaten. The *Iceland moss* is eaten in gruel and as bread, and is nutritious. It is an article of commerce, and is used in pharmacy, in pectoral lozenges and syrups. It is found on the mountains of New-Hampshire, and affords a rich purple dye, and stains marble green. Others afford other dyes. Litmus paper is colored by it.

FUCUS, C. 24, O. 7, T. 6, sp. 8-18, a sea weed growing in various places, and consisting of many varieties. It is eaten in Europe prepared in various ways. One kind is chewed as tobacco in Scotland. *Funguses* of different kinds are likewise much eaten cooked, near the sea coast. They are classed under the head *fuci*, and in different tribes. Some species are much esteemed in India. The *swallow's nest*, so celebrated, is a species, it is said, in a state of decomposition.

These are all cryptogamous plants, comprehending immense numbers of remarkable kinds, but few are used as food. Medicinally, fucus is deobstruent and efficacious in scrofulous swellings. This and other species are burnt for their ashes, which are the *kelp* of commerce.

CENOMYCE, C. 24, O. 8, T. 2, sp. 20-43, 2 ft. C. rangeferina is the famous lichen which for most of the year supports the vast herds of Rein-deer, in which is all the wealth of the Laplander. It grows in great abundance, most providentially.

EDIBLE WILD PLANTS.

This is a class of plants much used for food by man where vegetation is either luxurious or very scanty, and generally where man is little civilized. They have been chiefly cultivated by men more civilized, when found to be useful. Among those used in their wild state are the following:

WHITE BEET. This is found wild on the salt and marshy shores of Holland and other parts of Europe. It is hard and bitter, and is used as food only in cases of great necessity.

COUCH-GRASS, a well known and pestiferous plant with farmers, containing in its roots considerable nutriment. This, in times of scarcity and by travellers, has been resorted to as a source of food, and as a substitute for bread. During dry seasons in Africa the people gather the seeds of the grasses and make a miserable bread of them; but they appear like skeletons. One of these grasses is crowded with prickles and is painfully annoying to travellers.

THE SEA PEA, growing wild among stones and sands on the coast, has been considerably resorted to as an article of food. During a famine in England, in 1555, thousands of families were saved by this plant, found growing abundantly on the coast, and this seasonable relief was ascribed by the superstitious to the interposition of a *saint*; but he was not so fortunate as others unhonored with the title might have been; for more nutritious vegetables could have been found in the woods and by-ways in most parts of that country.

The Water Dragon Root affords food for the Laplanders in the form of bread, *(missen bread.)* The roots are chopped with a spade, then ground, and the meal boiled slowly in water, and stirred till thick. After standing some time its bitterness is expelled, and it is mixed with some other flour, when it makes a sweet and white bread. During scarcity it is fortunate if the peasant can obtain this to avoid a resort to the bark of the fir tree.

The Silver Weed is considerably resorted to in parts of Scotland to make bread of during scarcity. Some have subsisted on the roots for months. They are roasted or boiled, and have a flavor like the parsnip.

The Wild Carrot and Parsnip are also articles of food when other kinds are not to be obtained; and so also are other roots of the same

family. The *Wild Salsify* has been considerably used, but this, with the preceding, is greatly inferior to the cultivated kinds.

WILD CABBAGE, *brassicacam pestris* is found in most countries on the sea-coast. The leaves are used in spring, and are thought by some quite equal to the cultivated kind. The leaves have a saline and bitter taste, which is removed on boiling them in two waters. As the plants mature, however, they become unfit for use, from the accumulation of alkaline matter.

There are also many of the *spinacious plants*, of which we have spoken, that are gathered in their wild state for food. The *sorrel* is collected in large quantities for winter's use by the Laplanders. The leaves being boiled in water and stirred, are reduced to a pulp. This is then mixed with milk and put up in barrels or close vessels, and buried in holes in the ground, lined with bricks or birch bark. It has a very agreeable acid flavor. The people also avail themselves of many other plants rejected by us as poisonous, or unfit for use. The *yellow wolf's bane* is thus collected in large quantities and boiled and eaten. The poisonous qualities of this are evidently dissipated by heat, as probably almost all of those may be which we hold as poisonous.

Sea Kale, as we have before said, is much eaten as found growing wild on the coast of the north of Europe. The people of the west of England eat large quantities of it, being, when boiled, a very delicate plant.

The great cat's tail, growing in marshy places in this country, and most other countries, is considerably eaten by the people of parts of Europe, though rarely, if ever, here. In some parts of Turkey they are sold in shops and about the streets. The outer skin is peeled off near the roots, and the tender white stem for 18 inches is crisp, cooling, and a very pleasant food. It has been eaten by travellers with a good relish. It is particularly esteemed by the Cossacks.

Wild Cellery or *Smallage*, found on ditches near the sea, and also the *wild lettuce*, from which our cultivated kinds have sprung, are also eaten; likewise *Alisander* and *Rampion*, as salads. The *Cow-thistle*, growing on edges of mountains, is much eaten by the Laplanders. The milky stem is peeled and eaten raw; but, though very bitter, yet when boiled it loses much of that taste. The *Water Cress*, also a wild plant, is a great delicacy, as we have before described, together with *Samphire*, &c.

Many other wild plants are doubtless wholesome and capable of affording much nutriment, did necessity compel people to resort to them; but in this country, where the most nutritive vegetables are so abundant, no such necessity has yet existed, and we earnestly hope it may never occur with us. Still a notice of those wild plants which flourish when cultivated ones perish, may not be without its advantages.

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